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Experiment Data Report for LOFT Anticipated Transient Without Scram Experiment L9-3

Paul D. Bayless
Janice M. Divine

May 1982

Prepared for the
U.S. Nuclear Regulatory Commission
Under DOE Contract No. DE-AC07-76ID01570



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**EXPERIMENT DATA REPORT FOR LOFT
ANTICIPATED TRANSIENT
WITHOUT SCRAM EXPERIMENT L9-3**

**Paul D. Bayless
Janice M. Divine**

Published May 1982

**EG&G Idaho, Inc.
Idaho Falls, Idaho 83415**

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ABSTRACT

Selected pertinent and uninterpreted data from the third anticipated transient with multiple failures experiment (Experiment L9-3) conducted in the Loss-of-Fluid Test (LOFT) facility are presented. The LOFT facility is a 50-MW(t) pressurized water reactor (PWR) system with instruments that measure and provide data on the system thermal-hydraulic and nuclear conditions. The operation of the LOFT system is typical of large [~ 1000 MW(e)], commercial PWR operations.

Experiment L9-3 simulated a loss-of-feedwater anticipated transient without scram. The loss-of-feedwater accident led to an increase in the primary coolant system temperature and pressure. Both the experiment power-operated relief valve (PORV) and safety relief valve opened and were able to limit and control the pressure transient. The plant was then recovered with the control rods still withdrawn by injecting 7200-ppm borated water, manually cycling the PORV, and feeding and bleeding the steam generator.

SUMMARY

Experiment L9-3 was performed April 7, 1982, as part of the Loss-of-Fluid Test (LOFT) Experimental Program conducted by EG&G Idaho, Inc., for the U.S. Nuclear Regulatory Commission. Experiment L9-3 is part of the LOFT Anticipated Transient with Multiple Failures Experiment Series L9.

For the performance of Experiment L9-3, the LOFT facility was configured with a combined power-operated relief valve (PORV) and safety relief valve (SRV). Experiment L9-3 was initiated by turning off the secondary coolant system main feedwater pump. The failures that followed were the absence of both steam generator auxiliary feedwater injection and reactor scram. The steam generator steam control valve was closed manually at 67.3 ± 1.0 s. The liquid level in the steam generator dropped below the range of the level measurement at 94.5 ± 4.0 s. The pressurizer spray valve opened at 29.5 ± 2.0 s, the PORV opened at 73.8 ± 0.2 s, and the SRV opened at 96.8 ± 0.2 s. The peak primary coolant system pressure was reached at 96.8 ± 1.0 s.

Plant recovery was initiated at about 600 s by starting one high-pressure injection system (HPIS) pump, starting the secondary coolant system auxiliary feedwater and makeup pumps, and opening

the PORV. The control rods remained withdrawn. The HPIS injected high-concentration (~ 7200 ppm) boron. The PORV was closed when the pressure decreased to 14.98 ± 0.21 MPa. The feed to the steam generator was manipulated to keep the primary coolant system temperature between 583 and 594 K. The experiment was terminated approximately 10 min after the primary coolant system temperature first dropped to 583 K.

Experiment L9-3 was initiated from the following primary coolant system initial conditions: hot leg temperature, 576.4 ± 1.6 K; cold leg temperature, 557.0 ± 1.5 K; hot leg pressure, 14.98 ± 0.06 MPa; and intact loop flow rate, 467.6 ± 2.7 kg/s. The preexperiment power level was 48.7 ± 1.2 MW, with a maximum linear heat generation rate of 51.6 ± 3.9 kW/m.

Experiment L9-3 satisfied nearly all of the specified objectives; the one exception was that the peak pressure was not as high as desired. This report presents data in the form of graphs in SI and British units. In conjunction with data obtained from direct measurement, chosen computed variables are included to facilitate the analysis of the system thermal-hydraulic behavior.

ACKNOWLEDGMENT

Appreciation is expressed to the Data Systems Branch, particularly to J. B. Marlow for preparation of the data plots. Appreciation is also expressed to the LOFT Data Analysis Branch,

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CONTENTS

ABSTRACT	ii
SUMMARY	iii
ACKNOWLEDGMENT	iv
ACRONYMS	ix
1. INTRODUCTION	1
1.1 LOFT Experimental Program Objectives	1
1.2 Experiment L9-3 Objectives	3
2. EXPERIMENTAL PROCEDURE AND INITIAL CONDITIONS	4
2.1 Experimental Procedure	4
2.2 Initial Conditions	6
3. DATA PRESENTATION	13
4. REFERENCES	82
APPENDIX A—SYSTEM CONFIGURATION	83
APPENDIX B—MEASUREMENTS AND INSTRUMENTATION	89
APPENDIX C—PREEXPERIMENT PROCEDURES AND DATA CONSISTENCY CHECKS	175

FIGURES

1-1. LOFT piping schematic	2
2-1. LOFT power history prior to Experiment L9-3 initiation	4
2-2. LOFT decay heat following Experiment L9-3 initiation	6
A-1. LOFT major components	86
B-1. Relation of source and detectors to pipe for gamma densitometers	92
B-2. LOFT piping schematic with instrumentation	94
B-3. LOFT thermal-hydraulic instrumentation for intact loop	97
B-4. LOFT thermal-hydraulic instrumentation for broken loop	98
B-5. LOFT thermal-hydraulic instrumentation for pressure relief line	99

B-6.	LOFT blowdown suppression tank instrumentation	100
B-7.	LOFT reactor vessel instrumentation	101
B-8.	LOFT reactor vessel upper plenum DTT, LE, and TE elevations	102
B-9.	Cladding surface thermocouple locations for LOFT core	103
B-10.	In-core thermocouple locations for center fuel assembly	104
B-11.	LOFT pressurizer instrumentation	105
B-12.	LOFT steam generator instrumentation	106
B-13.	LOFT secondary coolant system instrumentation	107
B-14.	LOFT primary coolant pump instrumentation	108
B-15.	LOFT ECCS instrumentation—A train	109
B-16.	LOFT ECCS instrumentation—B train	110
B-17.	LOFT accumulator instrumentation	111

SHORT-TERM PLOTS (-50 to 200 s)

3S-1.	Valve position	31
3S-2.	Fluid density	31
3S-3.	Fluid velocity	32
3S-4.	Flow rate	32
3S-5.	Liquid level	33
3S-6.	Momentum flux	33
3S-7.	Local heat generation rate	34
3S-8—11.	Pressure	34—36
3S-12.	Power	36
3S-13,14.	Pump speed	37
3S-15—31.	Temperature	38—46

LONG-TERM PLOTS (0 to 1800 s)

3L-1.	Valve position	47
3L-2.	Fluid density	47

3L-3—8.	Fluid velocity	48—50
3L-9—12.	Flow rate	51,52
3L-13,14.	Liquid level	53
3L-15.	Momentum flux	54
3L-16.	Current	54
3L-17—21.	Differential pressure	55—57
3L-22—28.	Pressure	57—60
3L-29—49.	Temperature	61—71

COMPUTED VARIABLES

3C-1,4.	Mass flow rate	73, 74
3C-2,3,5.	Density-compensated liquid level	73—75
3C-6.	Fluid subcooling	75

VARIABLES WITH UNCERTAINTY BANDS

3U-1.	Fluid density	77
3U-2.	Mass flow rate	77
3U-3,4.	Liquid level	78
3U-5,6.	Pressure	79
3U-7.	Power	80
3U-8—10.	Temperature	80,81

TABLES

2-1.	Sequence of events for Experiment L9-3	5
2-2.	Plant trips for Experiment L9-3	7
2-3.	Initial conditions for Experiment L9-3	8
2-4.	Linear heat generation rate prior to Experiment L9-3	10
2-5.	Primary coolant temperatures at experiment initiation	11
2-6.	Water chemistry results for Experiment L9-3	12
3-1.	Measured variables for Experiment L9-3	14

3-2. Computed variables for Experiment L9-3	28
B-1. Nomenclature for LOFT instrumentation	95
B-2. Experiment L9-3 instrumentation list	112

ACRONYMS

ACC	Accumulator	PCP	Primary coolant pump
ATWS	Anticipated transient without scram	PCS	Primary coolant system
BST	Blowdown suppression tank	PORV	Power-operated relief valve
BWST	Borated water storage tank	PWR	Pressurized water reactor
DAVDS	Data acquisition and visual display system	QOBV	Quick-opening blowdown valve
DTT	Drag disc-turbine transducer	RABV	Reflood assist bypass valve
ECC	Emergency core cooling or coolant	RV	Reactor vessel
ECCS	Emergency core cooling system	SCS	Secondary coolant system
ESF	Engineered safety feature	SG	Steam generator
HPIS	High-pressure injection system	SRV	Safety relief valve
LOFT	Loss-of-Fluid Test	XRO	Orifice
LPIS	Low-pressure injection system		

EXPERIMENT DATA REPORT FOR LOFT ANTICIPATED TRANSIENT WITHOUT SCRAM EXPERIMENT L9-3

1. INTRODUCTION

This report presents selected pertinent and uninterpreted data from Experiment L9-3, which was conducted in the Loss-of-Fluid Test (LOFT) facility on April 7, 1982. Experiment L9-3 was the third anticipated transient with multiple failures experiment performed at LOFT and simulated a loss-of-feedwater anticipated transient without scram (ATWS).

The LOFT facility is a 50-MW(t) pressurized water reactor (PWR) with instrumentation to measure and provide data on the thermal-hydraulic and nuclear conditions throughout the system. Operation of the LOFT system is typical of large [~ 1000 MW(e)] commercial PWR operations. The LOFT facility consists of

1. A reactor vessel with a nuclear core
2. An intact loop with an active steam generator, pressurizer, and two primary coolant pumps connected in parallel
3. A broken loop with a simulated pump, simulated steam generator, and two quick-opening blowdown valve assemblies (the simulators were disconnected)
4. A blowdown suppression system consisting of a header, suppression tank, and a spray system
5. An emergency core coolant (ECC) injection system consisting of two low-pressure injection system (LPIS) pumps, two high-pressure injection system (HPIS) pumps, and two accumulators
6. A pressure relief pipeline from the top of the pressurizer to the suppression tank containing the experiment power-operated relief valve (PORV) and safety relief valve (SRV) in parallel with the pressure relief pipelines containing the plant PORV and SRVs.

Figure 1-1 presents the LOFT piping schematic. For additional information on the LOFT system, refer to Reference 1 and Appendix A of this report.

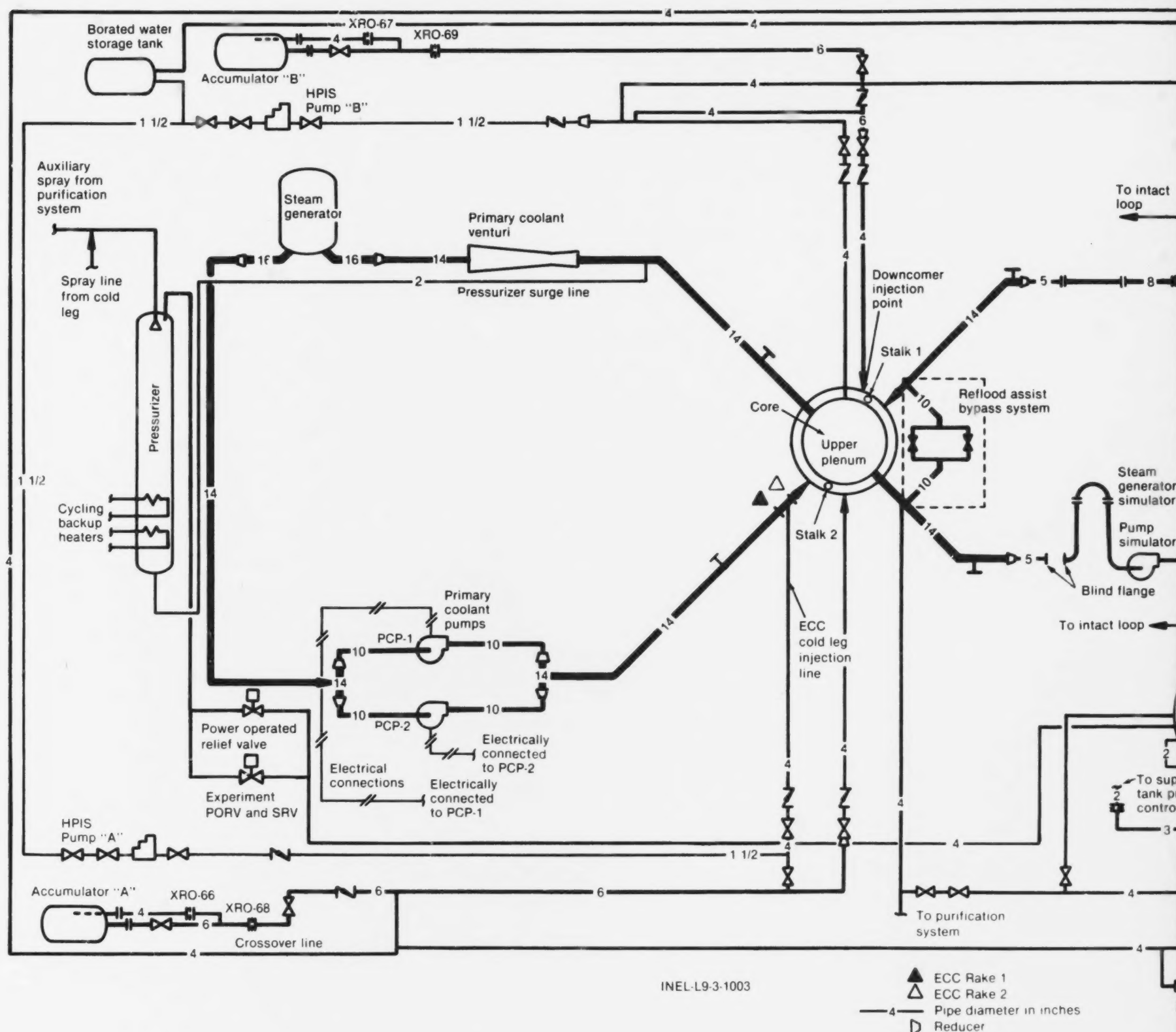
The data presented in this report are from 132 of the 708 instruments that provided data during Experiment L9-3. Only the data considered pertinent to the understanding of this experiment are presented. The data are in an uninterpreted but readily usable form for use by the nuclear community in advance of detailed analysis and interpretation. The data, in the form of graphs in engineering units, have been analyzed only to the extent necessary to ensure that they are reasonable and consistent.

Sections 1.1 and 1.2 state the LOFT Experimental Program objectives and the Experiment L9-3 objectives, respectively. Section 2 summarizes the experimental procedures and initial conditions. Section 3 presents the data with supporting information for data interpretation. Appendix A describes the LOFT system configuration. Appendix B describes the LOFT instrumentation system, the methods of obtaining various measurements, and a list of instruments available for use in Experiment L9-3. Appendix C summarizes the preexperiment calibrations and the methods used to verify the consistency and accuracy of the data.

1.1 LOFT Experimental Program Objectives

The LOFT integral^a test facility was designed to simulate the major components of a four-loop, commercial PWR, thereby producing data on the thermal, hydraulic, nuclear, and structural

a. The term "integral" is used to describe an experiment combining the nuclear, thermal, hydraulic, and structural processes occurring during a loss-of-coolant accident as distinguished from separate effects, nonnuclear, small-scale, and thermal-hydraulic experiments conducted for loss-of-coolant analysis.



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Figure 1-1. LOFT piping schematic.

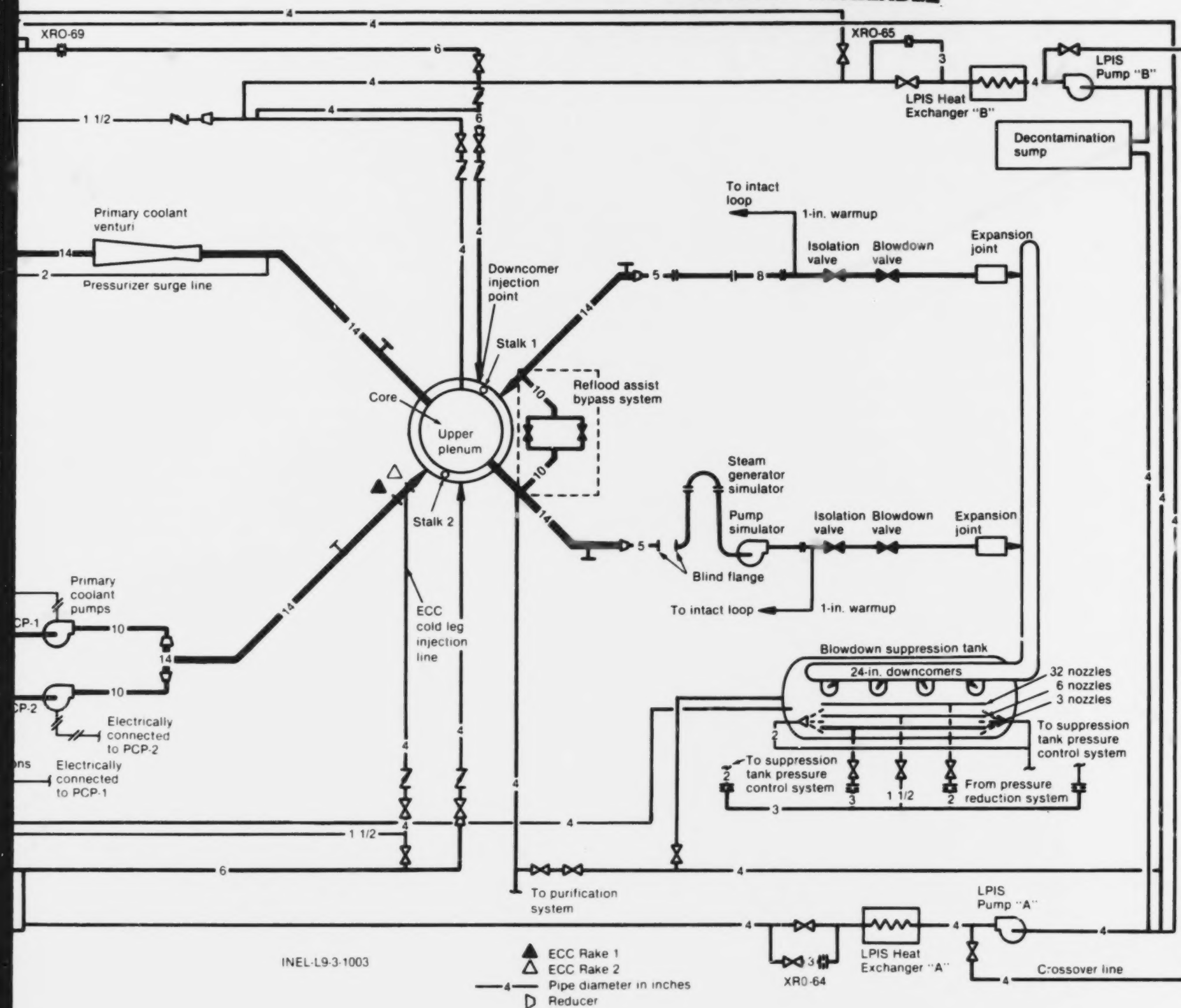


Figure 1-1. LOFT piping schematic.

processes expected to occur during a loss-of-coolant accident in a PWR. Reference 1 describes the LOFT facility in detail. The specific objectives of the LOFT Experimental Program are to

1. Provide data required to evaluate the adequacy of and to improve the analytical methods currently used to predict the response of large PWRs to postulated accident conditions, the performance of engineered safety features (ESFs) with particular emphasis on emergency core coolant systems (ECCS), and the quantitative margins of safety inherent in the performance of the ESFs
2. Identify and investigate any unexpected event(s) or threshold(s) in the response of either the plant or the ESFs and develop analytical techniques that adequately describe and account for the unexpected behavior(s)
3. Evaluate and develop methods to prepare, operate, and recover systems and plant for and from reactor accident conditions
4. Identify and investigate methods by which reactor safety can be enhanced, with emphasis on the interaction of the operator with the plant.

1.2 Experiment L9-3 Objectives

The programmatic objectives of Experiment L9-3 are to

1. Provide experimental data for benchmarking PWR vendors' ATWS computer codes as required by the U.S. Nuclear Regulatory Commission (NRC) proposed ATWS rule (USNRC SECY-80-409)²
2. Evaluate alternate methods of achieving long-term shutdown (without the insertion of control rods) following an ATWS event, to address concerns defined in the proposed NRC staff rule (Federal Register Vol. 46, No.226).

The Experiment L9-3 specific objectives are to

1. Achieve a maximum primary system pressure that is several measuring standard errors above the code safety valve opening pressure setpoint but below 110% of the setpoint pressure
2. Determine the transient reactor power by using available neutron flux instrumentation and measured core thermal-hydraulic parameters to assess the applicability of the point kinetics model used in predicting transient reactor power
3. Determine the steam generator secondary dryout behavior and its effect on the primary system response characteristics
4. Determine the two-phase and subcooled flow characteristics of the experimental pressurizer PORV and SRV at high pressures (≥ 17 MPa).

2. EXPERIMENTAL PROCEDURE AND INITIAL CONDITIONS

This section summarizes the experimental procedure and initial conditions recorded during the experiment.

2.1 Experimental Procedure

Initial reactor criticality occurred approximately 45 h prior to experiment initiation. The power level reached 49 ± 1 MW at 31 h prior to the experiment, and was maintained at approximately that level until Experiment L9-3 began. A plot of the power level versus time for the 50-h period prior to experiment initiation is given in Figure 2-1. These data are an average of the four power-range instruments.

Prior to initiating the experiment, a data acquisition and visual display system (DAVDS)³ calibration and a data integrity check were performed. During this period, the initial condition water samples were taken from the primary coolant system (PCS), the secondary coolant system (SCS), and the blowdown suppression tank (BST). Just prior to experiment initiation, the

purification lines were closed, the BST recirculation pumps were turned on, continuous steam generator blowdown flow was stopped and the reactor scrams were inhibited. The broken loop cold leg warmup recirculation flow and heaters on the broken loop hot leg and pressure relief line were maintained to keep fluid in the nonflowing pipe legs hot.

The DAVDS was activated and started recording data ~7 min prior to the experiment. The experiment was initiated by turning off the main feed pump. The sequence of events for the experiment is provided in Table 2-1. Figure 2-2 shows the decay heat during the experiment, which was calculated using the American Nuclear Society Standard 5.1⁴ assuming that a reactor scram occurred 400 s into the experiment.

The pressurizer spray valve opened at 29.5 ± 2.0 s, delivering a flow rate of 0.76 ± 0.13 L/s. The setpoints for this valve and other plant automatic actions are presented in Table 2-2. The steam generator steam control valve was closed manually at 67.3 ± 1.0 s. The

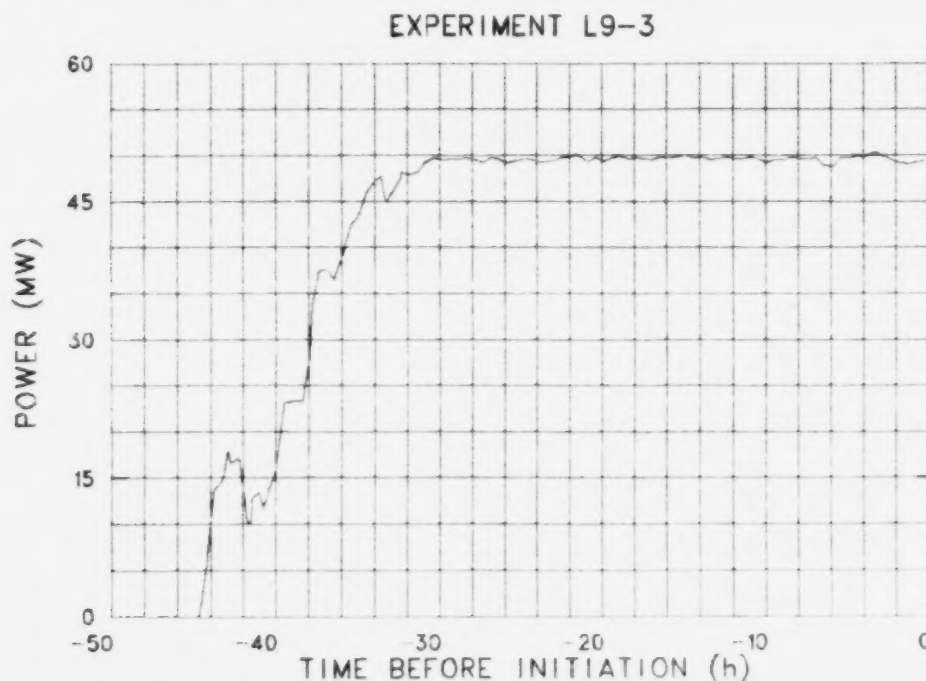


Figure 2-1. LOFT power history prior to Experiment L9-3 initiation.

TABLE 2-1. SEQUENCE OF EVENTS FOR EXPERIMENT L9-3

Event	Time after Experiment Initiation (s)
Main feedwater pump tripped off	0.0
Pressurizer spray valve cycling initiated	29.5 $\pm$ 2.0
Steam generator steam control valve closed	67.3 $\pm$ 1.0
Experiment PORV opened	73.8 $\pm$ 0.2
Pressurizer liquid level reached top of indicating range (1.83 m above bottom)	90.0 $\pm$ 0.4
Steam generator liquid level reached bottom of indicating range (0.25 m above tube sheet)	94.5 $\pm$ 4.0
Experiment SRV opened	96.8 $\pm$ 0.2
Experiment SRV closed	107 $\pm$ 1
Experiment PORV closed	123 $\pm$ 1
Experiment PORV cycling initiated	125.4 $\pm$ 0.2
HPIS flow initiated	601.1 $\pm$ 0.2
Steam generator makeup and auxiliary feed initiated	608.3 $\pm$ 4.0
Experiment PORV held open	612.6 $\pm$ 0.2
Experiment PORV closed	618.6 $\pm$ 0.2
Steam generator feed terminated	673.6 $\pm$ 4.0
Steam generator feed reinitiated	772.7 $\pm$ 4.0
PCS temperature first drops to 583 K	1080 $\pm$ 20
Steam generator feed terminated	1080.0 $\pm$ 2.0
Experiment PORV manual cycling initiated	1124.4 $\pm$ 2.0
Steam generator feed cycling initiated	1125.0 $\pm$ 2.0
Steam generator feed cycling terminated	1300.0 $\pm$ 4.0
Experiment completed	1680 $\pm$ 20

EXPERIMENT L9-3

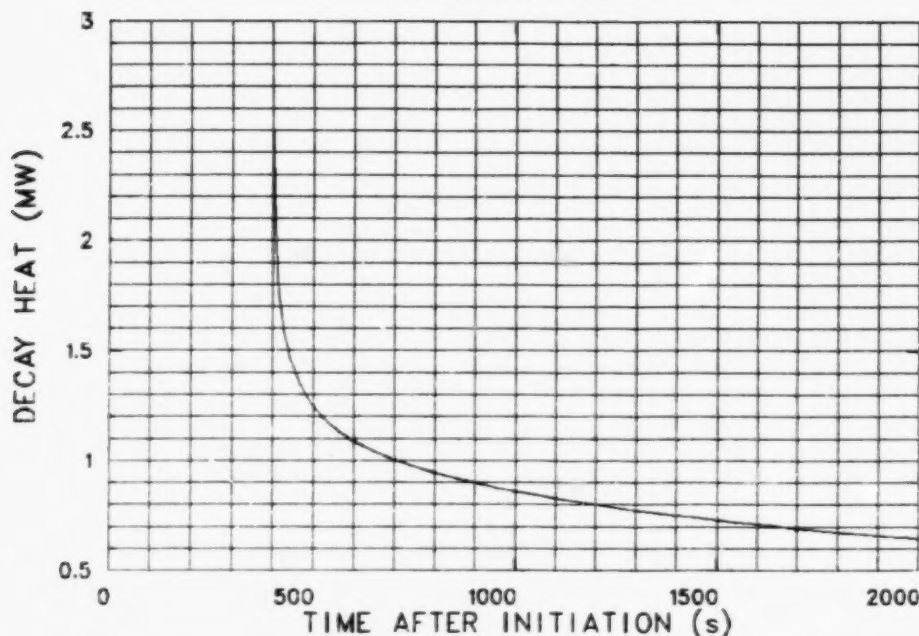


Figure 2-2. LFT decay heat following Experiment L9-3 initiation.

experiment PORV opened at 73.8 ± 0.2 s, and the experiment SRV opened at 96.8 ± 0.2 s. Appendix A contains a description of the combined experiment PORV and SRV, and information on the valve calibration.

At approximately 600 s, the recovery procedure was initiated by starting HPIS injection, starting the steam generator auxiliary feedwater and makeup pumps, and opening the experiment PORV. A supply of 984 ± 38 L of 7000 ± 200 -ppm boron was available to the HPIS pump, which injected it to the downcomer at a rate of 0.38 ± 0.06 L/s. The HPIS pump operated as a PCS makeup pump; normal ECC flow was inhibited. The experiment PORV was closed at 618.6 ± 0.2 s when the PCS pressure decreased to 14.98 ± 0.21 MPa. The steam generator feed was manually controlled to keep the PCS temperature between 583 and 594 K. The main steam bypass valve was opened as necessary to keep the steam generator pressure below 6.89 MPa. The experiment PORV was cycled as necessary to keep the PCS pressure between 15.0 and 15.6 MPa. The experiment was terminated at 1680 ± 20 s, approximately 600 s after the PCS temperature first dropped to 583 K. Throughout the experiment, the control rods remained

withdrawn and the primary coolant pumps were running. The pressurizer heaters were turned on at the beginning of the recovery procedure.

The BST pressure was not controlled because the back pressure was not expected to affect the experiment. Blowdown suppression tank recirculation through the spray headers was performed at full spray pump capacity throughout the transient to ensure that homogeneous temperatures would be maintained throughout the water volume in the BST.

The DAVDS recorded approximately 29 min of data after the main feed pump was tripped. An electrical calibration of the DAVDS was performed following the experiment.

2.2 Initial Conditions

The specified initial plant operating conditions (except for the linear heat generation rate) for Experiment L9-3 are presented in Table 2-3, along with the values measured immediately prior to experiment initiation. Table 2-4 gives the linear heat generation rate versus core height for three

TABLE 2-2. PLANT TRIPS FOR EXPERIMENT L9-3

<u>Trip</u>	<u>Setpoint^a</u>	<u>Measurement Location</u>
<u>Reactor</u>		
High-pressure scram	Inhibited	Intact loop hot leg
Low-pressure scram	Inhibited	Intact loop hot leg
High-temperature scram	Inhibited	Intact loop hot leg
Low-flow scram	Inhibited	Intact loop hot leg
<u>Pressurizer</u>		
Spray on	15.32 MPa	Pressurizer
Spray off	15.16 MPa	Pressurizer
Cycling heaters on (36 kW)	14.85 MPa	Pressurizer
Cycling heaters off (36 kW)	15.05 MPa	Pressurizer
Backup heaters on (12 kW)	14.81 MPa	Pressurizer
Backup heaters off (12 kW)	14.92 MPa	Pressurizer
<u>Relief valves</u>		
Experiment PORV open	16.20 MPa	Pressurizer
Experiment PORV reset	16.00 MPa	Pressurizer
Experiment SRV open	17.24 MPa	Pressurizer
Experiment SRV reset	16.46 MPa	Pressurizer
Plant PORV open	19.10 MPa	Pressurizer
Plant PORV reset	18.96 MPa	Pressurizer
Plant SRVs open	19.31 MPa	Pressurizer
Plant SRVs reset	16.36 MPa	Pressurizer
<u>Secondary coolant system</u>		
Main steam control valve open	7.12 MPa	Main steam line
Main steam control valve stop opening	6.98 MPa	Main steam line
Main steam control valve close	6.50 MPa	Main steam line
Main steam control valve stop closing	6.57 MPa	Main steam line
<u>Emergency core cooling system</u>		
HPIS on	Inhibited	Intact loop hot leg

a. The trip may vary within the measurement uncertainty of the setpoint, which is typically ± 0.21 MPa.

TABLE 2-3. INITIAL CONDITIONS FOR EXPERIMENT L9-3

Parameter	Specified Value	Measured Value
<u>Primary Coolant System</u>		
Mass flow (kg/s)	--	467.6 $\pm$ 2.7
Hot leg pressure (MPa)	14.95 $\pm$ 0.10	14.98 $\pm$ 0.06
Core ΔT (K)	21.1 $\pm$ 1.1	19.4 $\pm$ 2.2 ^a
Intact loop average temperature (K)	568.2 $\pm$ 0.6 - 1.7	566.7 $\pm$ 1.5
Cold leg temperature (K)	--	557.0 $\pm$ 1.5
Hot leg temperature (K)	--	576.4 $\pm$ 1.6
Boron concentration (ppm)	--	694 $\pm$ 15
<u>Reactor Vessel</u>		
Power level (MW)	49.5 $\pm$ 0.5	48.7 $\pm$ 1.2 ^a
Maximum linear heat generation rate (kW/m)	--	51.6 $\pm$ 3.9
Control rod position (above full-in position) (m)	1.372 $\pm$ 0.013	1.376 $\pm$ 0.010
<u>Pressurizer</u>		
Steam volume (m ³)	--	0.40 $\pm$ 0.02
Liquid volume (m ³)	--	0.53 $\pm$ 0.02
Liquid temperature (K)	--	615.2 $\pm$ 0.3
Pressure (MPa)	14.95 $\pm$ 0.10	14.98 $\pm$ 0.06
Liquid level (m)	1.09 $\pm$ 0.03 - 0.05	1.00 $\pm$ 0.03 ^a
<u>Broken Loop</u>		
Cold leg temperature near reactor vessel (K)	569 $\pm$ 17	557.4 $\pm$ 4.3
Hot leg temperature near reactor vessel (K)	--	560.2 $\pm$ 4.3
<u>Steam Generator Secondary Side</u>		
Liquid level (m) ^b	0.25 $\pm$ 0.05	0.20 $\pm$ 0.09
Liquid temperature (K)	--	544.4 $\pm$ 0.7
Pressure (MPa)	--	5.61 $\pm$ 0.06
Mass flow (kg/s)	--	25.7 $\pm$ 1.1

TABLE 2-3. (continued)

Parameter	Specified Value	Measured Value
<u>Suppression Tank</u>		
Liquid level (m)	1.27 ± 0.05	1.34 ± 0.03^a
Liquid volume (m ³)	--	31.70 ± 0.84
Gas volume (m ³)	--	53.96 ± 0.84
Liquid temperature (K)	350.9 to 374.5	359.5 ± 3.0
Pressure (gas space)(MPa)	0.085 to 0.147	0.129 ± 0.006

a. Out of specification, but did not impair results.

b. The liquid level is defined as 0.0 at 2.95 m above the top of the tube sheet.

locations within the LOFT core prior to experiment initiation. The data for Table 2-4 were obtained from the traversing in-core probe system.

Table 2-5 gives the measured fluid temperatures of the PCS immediately prior to experiment initiation.

Table 2-6 specifies the required water chemistry for the PCS, the BST, and the SCS. In addition, the results of the water chemistry analyses are presented for preexperiment conditions in these systems, and for postexperiment conditions in the BST.

TABLE 2-4. LINEAR HEAT GENERATION RATE PRIOR TO EXPERIMENT L9-3
(Reading Uncertainty $\pm 7.6\%$)

Position Height Above Core Bottom (m)	Linear Heat Generation Rate for Core Position (kW/m)		
	1C7	5H8	5M3
0.152	10.96	19.81	20.01
0.292	22.78	39.47	38.96
0.394	25.29	43.82	43.26
0.456	24.20	41.95	41.41
0.503	25.97	45.00	44.41
0.546	28.16	47.83	47.22
0.648	28.73	48.80	48.18
0.749	28.80	46.91	46.96
0.846	26.40	42.99	43.03
0.886	24.20	39.43	39.47
0.953	25.08	40.85	40.89
1.054	22.92	37.33	37.37
1.181	19.16	31.20	31.23
1.257	16.25	25.74	26.07
1.299	13.35	21.76	21.78
1.359	11.58	18.89	18.90
1.511	5.65	10.22	9.58
1.613	2.62	5.86	5.09
1.664	1.59	3.32	3.09

TABLE 2-5. PRIMARY COOLANT TEMPERATURES AT EXPERIMENT INITIATION

Location	Detector	Temperature (K)
Intact-loop hot leg (near vessel)	TE-PC-002B	577.7 $\pm$ 4.1
Intact-loop steam generator outlet	TE-SG-002	557.0 $\pm$ 4.3
Intact-loop cold leg (near vessel)	TE-PC-005	558.2 $\pm$ 4.3
Reactor vessel downcomer (Instrument Stalk 1)	TE-1ST-001	557.8 $\pm$ 4.0
Reactor vessel lower plenum	TE-1LP-001	558.2 $\pm$ 4.0
Reactor vessel upper plenum	TE-1UP-001	584.2 $\pm$ 4.2
	TE-4UP-001	572.2 $\pm$ 4.1
	TE-5UP-001	587.0 $\pm$ 4.2
Broken-loop hot leg (near vessel)	TE-BL-002B	560.2 $\pm$ 4.3
Broken-loop cold leg (near vessel)	TE-BL-001B	557.4 $\pm$ 4.3
Intact-loop pressurizer (from saturation pressure)	PE-PC-004	615.2 $\pm$ 0.7

TABLE 2-6. WATER CHEMISTRY RESULTS FOR EXPERIMENT L9-3

Parameter	Primary Coolant System		Blowdown Suppression Tank			Secondary Coolant System	
	Specified	Preexperiment ^a	Specified	Preexperiment	Postexperiment	Specified	Preexperiment
pH (each at 298 K)	4.2 to 10.5	6.18	4.2 to 10.5	4.92	4.98	9.0 to 10.2	10.00
Conductivity ($\mu\text{mho}/\text{cm}^3$) (each at 298 K)	60 maximum	4.79	60 maximum	13.2	12.55	2 maximum ^b	1.4
Total gas (cm^3/kg)	100 maximum	33	--	--	--	--	--
Dissolved oxygen (ppm)	--	--	--	--	--	0.005 maximum	0.042
Chloride (ppm)	0.15 maximum	<0.1	0.15 maximum	<0.1	<0.1	0.15 maximum	<0.1
Undissolved solids (ppm)	1.0 maximum	<0.5	1.0 maximum	<0.5	<0.5	1.0 maximum	65.2
Boron (ppm)	--	689	> 3050	3674	3591	--	--
Fluoride (ppm)	0.1 maximum	<0.02	0.1 maximum	<0.02	<0.02	--	--
Hydrogen (cm^3/kg) ^c	10 to 60	16	--	--	--	--	--
Total gross activity ($\mu\text{Ci}/\text{mL}$)	375 maximum	0.13	--	--	--	--	--
Gross beta and gamma ($\mu\text{Ci}/\text{mL}$)	--	0.13	--	--	2.3×10^{-4}	--	--
^{131}I ($\mu\text{Ci}/\text{mL}$)	0.37 maximum	0.0	--	--	0.0	9×10^{-4} maximum	0.0
^{135}I ($\mu\text{Ci}/\text{mL}$)	0.76 maximum	0.0	--	--	0.0	--	0.0

a. Sample taken upstream from the primary coolant system ion exchanger.

b. Cation conductivity.

c. Prior to depressurization.

3. DATA PRESENTATION

The data presented in this report are selected pertinent and uninterpreted thermal-hydraulic and nuclear data from LOFT Experiment L9-3. The experiment data have been divided into two categories, "Qualified" and "Failed." The "Qualified" designation was applied to measurements that have been found to be within the uncertainty of the instrument. The absence of a comment following the "Qualified" designation indicates that the data are valid (that is, within specified uncertainty bands) over the entire time span recorded. Restrictive statements accompany data that are invalid or questionable over a portion of the recorded time span. All the data presented in this report are "Qualified". The plot captions contain only applicable restrictive statements; if no statement appears, the data are "Qualified". Data that are not presented are available from EG&G Idaho, Inc. upon special request. The checks on data consistency and instrument performance are discussed in detail in Appendix C. Any information concerning calibration data may be received by contacting the LOFT Data Analysis Branch Manager.

The data were processed and are presented in graphical form in SI units. British units and accompanying tick marks are also included. Most of the data were collected at a rate of five samples per second. Short-term plots contain 1250 points. Plots of longer time frames were reduced to 2000 or fewer points for ease of plotting. This was accomplished by dividing the time span into approximately 1000 constant increments and plotting only the minimum and maximum values in each increment. The resulting plot looks identical to a plot produced by plotting every point because of the finite resolution of the plotting device.

Uncertainties for experimental measurements and computed variables are of the form $\pm \sqrt{(B)^2 + (M \times RD/100)^2}$, where B is the bias (offset) uncertainty, RD is the percentage-of-reading uncertainty, and M is the measurement reading at a particular time. The uncertainties supplied on the plots were calculated for M equal to the maximum data value to ensure that the uncertainties are conservative. Uncertainties for process instruments are of the form $\pm RG/100$, where RG is a percentage-of-range uncertainty. The values B, RD, and RG are calculated at the 95% confidence level. Uncertainty values are presented in Table B-2 of Appendix B and on each plot.

Uncertainty bands on selected measurements are presented for ease in code comparison. The uncertainties are fixed values calculated at the upper range of the recorded data so as to be conservative. On certain plots, the uncertainty band may exceed a physical limit, such as a density below zero. This is a result of the plotting software and does not represent a real phenomenon.

The design ranges of the instruments are also presented on each plot. In some cases, the instrument range exceeds its design range. Computed variables are calculated from several measurements and thus do not have a design range.

Table 3-1 lists the Experiment L9-3 measurements presented in this report and gives the detector location and the figure numbers. In addition, this table contains a "Comments" column which gives information pertaining to the qualification of the data. A list of instruments available for Experiment L9-3 is included in Table B-2.

Table 3-2 lists the variables that were computed from other measurements and geometrical constants. This table also gives the equations used to compute these variables, the figure number, and comments which reflect on the usefulness of the data.

The data are divided into four major sections with the individual plots in each section being presented in alphanumeric order to facilitate comparison and location of desired variables. These data sections include:

1. Experiment L9-3 Measured Variables, Short-Term Plots (-50 to 200 s), Figures 3S-1 through 3S-31
2. Experiment L9-3 Measured Variables, Long-Term Plots (0 to 1800 s), Figures 3L-1 through 3L-49
3. Experiment L9-3 Computed Variables, Figures 3C-1 through 3C-6
4. Experiment L9-3 Variables with Uncertainty Bands, Figures 3U-1 through 3U-10.

TABLE 3-1. MEASURED VARIABLES FOR EXPERIMENT L9-3

Variable, System, and Detector	Location	Figure Number	Comments
VALVE OPENING			
<u>Secondary Coolant System</u>			
CV-P004-010	Main steam control valve.	3S-1	Qualified, no other measurement to verify magnitude.
<u>Intact Loop</u>			
CV-P139-05-1	Pressurizer spray valve.	3L-1	Qualified.
DENSITY			
<u>Intact Loop</u>			
DE-PC-S03A	Pressure relief line.	3S-2	Qualified.
	Chordal density upstream	3L-2	
	of experiment relief valve.	3U-1	
FLUID VELOCITY			
<u>Intact Loop</u>			
FE-PC-S02	Pressure relief line.	3S-3	Qualified.
	Upstream from experiment relief valve.	3L-3	
FE-PC-001B	Cold leg drag-disc turbine transducer (DTT) horizontal flange at center of pipe.	3L-4	Qualified.
FE-PC-002B	Hot leg DTT flange at middle of pipe.	3L-5	Qualified.
<u>Reactor Vessel</u>			
FE-1ST-001	Downcomer Stalk 1.	3L-6	Qualified, normal- ized to indicate average flow in downcomer.
FE-5LP-001	Lower end box of Fuel Assembly 5.	3L-7	Qualified, normal- ized to indicate average flow in the lower plenum.

TABLE 3-1. (continued)

<u>Variable, System, and Detector</u>	<u>Location</u>	<u>Figure Number</u>	<u>Comments</u>
FLUID VELOCITY (continued)			
<u>Reactor Vessel</u> (continued)			
FE-5LP-002	Lower end box of Fuel Assembly 5.	3L-7	Qualified, normalized to indicate average flow in the lower plenum.
FE-5UP-001	Above upper end box of Fuel Assembly 5.	3L-8	Qualified, normalized to indicate average flow in the upper plenum.
FLOW RATE			
<u>Secondary Coolant System</u>			
FT-P004-012	Inlet to air-cooled condenser inlet header.	3S-4	Qualified, forced to agree with reactor power at initial conditions.
FT-P004-062A	Auxiliary feedwater and makeup pumps discharge flow.	3L-9	Qualified to 1080 s, failed thereafter.
FT-P004-090	Steam flow control bypass line.	3L-10	Qualified, no other measurement to verify magnitude, possible zero offset drift.
<u>Emergency Core Cooling System</u>			
FT-P128-085	High-pressure injection system (HPIS) Pump B discharge.	3L-11	Qualified, no other measurement for direct comparison.
<u>Intact Loop</u>			
FT-P139-27-2	Hot leg venturi flowmeter (bottom of pipe).	3L-12	Qualified.

TABLE 3-1. (continued)

<u>Variable, System, and Detector</u>	<u>Location</u>	<u>Figure Number</u>	<u>Comments</u>
LIQUID LEVEL			
<u>Secondary Coolant System</u>			
LT-P004-008B	Steam generator (SG) (wide range).	3S-5 3L-13	Qualified.
<u>Blowdown Sup- pression Tank</u>			
LT-P138-058	Blowdown suppression tank (BST) level on south end of tank.	3L-14	Qualified.
MOMENTUM FLUX			
<u>Intact Loop</u>			
ME-PC-S02	Pressure relief line. Upstream from experiment relief valve.	3S-6 3L-15	Qualified, shows negative momentum due to unresolvable temperature compensation.
NEUTRON DETECTION			
<u>Reactor Vessel</u>			
NE-6H08-26	Neutron detector in Fuel Assembly 6.	3S-7	Qualified.
ELECTRICAL CURRENT			
<u>Intact Loop</u>			
PCP-1-I-RMS	Primary Coolant Pump (PCP) 1.	3L-16	Qualified.
PCP-2-I-RMS	PCP-2.	3L-16	Qualified.

TABLE 3-1. (continued)

Variable, System, and Detector	Location	Figure Number	Comments
DIFFERENTIAL PRESSURE			
<u>Intact Loop</u>			
PdE-PC-001	Cold leg across PCPs.	3L-17	Qualified.
PdE-PC-002	Across SG.	3L-18	Qualified.
PdE-PC-003	Hot leg piping, reactor vessel (RV) to SG inlet.	3L-19	Qualified.
PdE-PC-005	Cold leg piping, PCPs to RV nozzle.	3L-20	Qualified, clipped at 27.4 kPa.
PdT-P139-030	Across RV just beyond intact loop inlet and outlet nozzles.	3L-21	Qualified.
PRESSURE			
<u>Intact Loop</u>			
PE-PC-S05	Pressure relief line upstream from experiment relief valve.	3S-8	Qualified.
PE-PC-S06	Pressure relief line upstream from experiment relief valve.	3L-22	Qualified.
PE-PC-S07	Pressure relief line downstream from experiment relief valve.	3L-23	Qualified.
PE-PC-004	Pressurizer vapor space.	3S-8	Qualified.
PE-PC-005	Reference pressure between SG outlet and PCP inlet.	3S-9	Qualified.
PE-PC-006	Reference pressure between SG outlet and PCP inlet.	3L-24	Qualified.

TABLE 3-1. (continued)

<u>Variable, System, and Detector</u>	<u>Location</u>	<u>Figure Number</u>	<u>Comments</u>
<u>Secondary Coolant System</u>			
PE-SGS-001	SG dome pressure.	3S-10 3U-5	Qualified.
<u>Reactor Vessel</u>			
PE-1ST-001A	Downcomer Stalk 1, 0.62 m above RV bottom.	3L-25	Qualified.
PE-1UP-001A	Above Fuel Assembly 1 upper end box.	3S-11	Qualified.
PE-1UP-001A1	Above Fuel Assembly 1 upper end box.	3U-6	Qualified.
<u>Secondary Coolant System</u>			
PT-P004-010A	In 10-in. line from SG.	3L-26	Qualified.
<u>Intact Loop</u>			
PT-P139-002	Hot leg at venturi on bottom.	3L-27	Qualified.
PT-P139-05-1	Pressurizer, 1.88 m above bottom (vapor space).	3L-28	Qualified.
REACTIVITY			
<u>Reactor Vessel</u>			
RE-T-77-1A2	Power range, Channel A level.	3S-12	Qualified.
RE-T-77-2A2	Power range, Channel B level.	3S-12 3U-7	Qualified.
RE-T-77-3A2	Power range, Channel C level.	3S-12	Qualified.

TABLE 3-1. (continued)

<u>Variable, System, and Detector</u>	<u>Location</u>	<u>Figure Number</u>	<u>Comments</u>
PUMP SPEED			
<u>Intact Loop</u>			
RPE-PC-001	PCP-1.	3S-13	Qualified.
RPE-PC-002	PCP-2.	3S-14	Qualified.
TEMPERATURE			
<u>Reactor Vessel</u>			
TC-5C07-27	Centerline of Fuel Assembly 5, Row C, Column 7 at 0.69 m above bottom of fuel rod.	3S-15	Qualified.
TC-5D06-27	Centerline of Fuel Assembly 5, Row D, Column 6 at 0.69 m above bottom of fuel rod.	3L-29	Qualified.
TC-5D07-27	Centerline of Fuel Assembly 5, Row D, Column 7 at 0.69 m above bottom of fuel rod.	3S-15	Qualified.
TC-5D10-27	Centerline of Fuel Assembly 5, Row D, Column 10 at 0.69 m above bottom of fuel rod.	3S-15	Qualified.
<u>Broken Loop</u>			
TE-BL-001B	Cold leg DTT flange at middle of pipe.	3L-30	Qualified, no other measurement for direct comparison.
TE-BL-002B	Hot leg DTT flange at middle of pipe.	3L-31	Qualified, no other measurement for direct comparison.

TABLE 3-1. (continued)

Variable, System, and Detector	Location	Figure Number	Comments
TEMPERATURE (continued)			
<u>Intact Loop</u>			
TE-PC-S03	Pressure relief line upstream from experiment relief valve.	3L-32	Qualified.
TE-PC-S04	Pressure relief line upstream from experiment relief valve.	3S-16	Qualified.
TE-PC-S05	Pressure relief line downstream from experiment relief valve.	3L-33	Qualified.
TE-PC-001B	Cold leg DTT horizontal flange at center of pipe.	3U-8	Qualified.
TE-PC-002A	Hot leg DTT flange at bottom of pipe.	3S-17	Qualified
TE-PC-002B	Hot leg DTT flange at middle of pipe.	3L-34	Qualified.
TE-PC-002C	Hot leg DTT flange at top of pipe.	3U-9	Qualified.
TE-PC-005	Next to bottom of ECC Rake 1.	3L-35	Qualified.
TE-PC-006	Next to top of ECC Rake 1.	3S-18 3L-35	Qualified.
TE-P139-019	Pressurizer vapor space, 0.86 m above heater rods.	3S-19	Qualified.
TE-P139-020	Pressurizer liquid volume, 0.36 m above heater rods.	3S-20 3U-10	Qualified.
TE-P139-20-1	Pressurizer liquid volume.	3L-36	Qualified.
TE-SG-001A	SG inlet plenum.	3S-21	Qualified.
TE-SG-002A	SG outlet plenum.	3S-21	Qualified.

TABLE 3-1. (continued)

<u>Variable, System, and Detector</u>	<u>Location</u>	<u>Figure Number</u>	<u>Comments</u>
TEMPERATURE (continued)			
<u>Secondary Coolant System</u>			
TE-SG-003	SG secondary side down- comer, 0.25 m above top of tube sheet.	3S-22 3L-37	Qualified.
TE-SG-005	SG secondary side down- comer, 2.92 m above top of tube sheet.	3S-22	Qualified.
<u>Blowdown Suppression System</u>			
TE-SV-006	BST, 0.3 m north of Down- comer 1, 0.53 m east of tank centerline, 0.37 m from tank bottom.	3L-38	Qualified.
TE-SV-011	BST, 0.3 m north of Down- comer 3, 0.53 m east of tank centerline, 0.99 m from tank bottom.	3L-38	Qualified.
<u>Reactor Vessel</u>			
TE-1F07-015	Fuel Assembly 1, Row F, Column 7, 0.38 m above bottom of fuel rod.	3S-23	Qualified.
TE-1F07-021	Fuel Assembly 1, Row F, Column 7, 0.53 m above bottom of fuel rod.	3S-23	Qualified.
TE-1F07-026	Fuel Assembly 1, Row F, Column 7, 0.66 m above bottom of fuel rod.	3S-23	Qualified.
TE-1F07-030	Fuel Assembly 1, Row F, Column 7, 0.76 m above bottom of fuel rod.	3S-23	Qualified.

TABLE 3-1. (continued)

<u>Variable, System, and Detector</u>	<u>Location</u>	<u>Figure Number</u>	<u>Comments</u>
TEMPERATURE (continued)			
<u>Reactor Vessel (continued)</u>			
TE-1UP-001	Fuel Assembly 1, upper end box.	3S-24	Qualified.
TE-2UP-001	Fuel Assembly 2, upper end box.	3S-24	Qualified.
TE-3B12-026	Cladding on Fuel Assembly 3, Row B, Column 12 at 0.66 m above bottom of fuel rod.	3L-39	Qualified.
TE-3C11-021	Cladding on Fuel Assembly 3, Row C, Column 11 at 0.53 m above bottom of fuel rod.	3L-39	Qualified.
TE-3C11-039	Cladding on Fuel Assembly 3, Row C, Column 11 at 0.99 m above bottom of fuel rod.	3L-39	Qualified.
TE-3UP-001	Fuel Assembly 3, upper end box.	3L-40	Qualified.
TE-3UP-008	Liquid level transducer above Fuel Assembly 3.	3L-41	Qualified.
TE-3UP-010	Liquid level transducer above Fuel Assembly 3.	3L-41	Qualified.
TE-3UP-011	Liquid level transducer above Fuel Assembly 3.	3L-41	Qualified.
TE-3UP-012	Liquid level transducer above Fuel Assembly 3.	3L-40	Qualified.
TE-3UP-014	Liquid level transducer above Fuel Assembly 3.	3L-40	Qualified.
TE-3UP-016	Liquid level transducer above Fuel Assembly 3.	3L-40	Qualified.
TE-4G02-030	Cladding on Fuel Assembly 4, Row G, Column 2 at 0.76 m above bottom of fuel rod.	3L-42	Qualified.

TABLE 3-1. (continued)

Variable, System, and Detector	Location	Figure Number	Comments
TEMPERATURE (continued)			
<u>Reactor Vessel</u> (continued)			
TE-4I02-021	Cladding on Fuel Assembly 4, Row I, Column 2 at 0.53 m above bottom of fuel rod.	3L-42	Qualified.
TE-4I02-039	Cladding on Fuel Assembly 4, Row I, Column 2 at 0.99 m above bottom of fuel rod.	3L-42	Qualified.
TE-5C07-027	Cladding on Fuel Assembly 5, Row C, Column 7 at 0.69 m above bottom of fuel rod.	3L-43	Qualified.
TE-5C07-031	Cladding on Fuel Assembly 5, Row C, Column 7 at 0.79 m above bottom of fuel rod.	3L-43	Qualified.
TE-5F08-026	Cladding on Fuel Assembly 5, Row F, Column 8 at 0.66 m above bottom of fuel rod.	3L-44	Qualified.
TE-5G06-011	Cladding on Fuel Assembly 5, Row G, Column 6 at 0.28 m above bottom of fuel rod.	3S-25	Qualified.
TE-5G06-030	Cladding on Fuel Assembly 5, Row G, Column 6 at 0.76 m above bottom of fuel rod.	3S-25	Qualified.
TE-5G06-045	Cladding on Fuel Assembly 5, Row G, Column 6 at 1.14 m above bottom of fuel rod.	3S-25	Qualified.
TE-5G06-062	Cladding on Fuel Assembly 5, Row G, Column 6 at 1.57 m above bottom of fuel rod.	3S-25	Qualified.
TE-5H06-024	Cladding on Fuel Assembly 5, Row H, Column 6 at 0.61 m above bottom of fuel rod.	3S-26	Qualified.

TABLE 3-1. (continued)

Variable, System, and Detector	Location	Figure Number	Comments
TEMPERATURE (continued)			
<u>Reactor Vessel</u> (continued)			
TE-5H06-028	Cladding on Fuel Assembly 5, Row H, Column 6 at 0.71 m above bottom of fuel rod.	3S-26	Qualified.
TE-5H06-032	Cladding on Fuel Assembly 5, Row H, Column 6 at 0.81 m above bottom of fuel rod.	3S-26	Qualified.
TE-5H06-037	Cladding on Fuel Assembly 5, Row H, Column 6 at 0.94 m above bottom of fuel rod.	3S-26	Qualified.
TE-5I06-005	Cladding on Fuel Assembly 5, Row I, Column 6 at 0.13 m above bottom of fuel rod.	3L-45	Qualified.
TE-5I06-021	Cladding on Fuel Assembly 5, Row I, Column 6 at 0.53 m above bottom of fuel rod.	3L-45	Qualified.
TE-5I06-039	Cladding on Fuel Assembly 5, Row I, Column 6 at 0.99 m above bottom of fuel rod.	3L-45	Qualified.
TE-5I06-054	Cladding on Fuel Assembly 5, Row I, Column 6 at 1.37 m above bottom of fuel rod.	3L-45	Qualified.
TE-5J04-005	Cladding on Fuel Assembly 5, Row J, Column 4 at 0.13 m above bottom of fuel rod.	3S-27	Qualified.
TE-5J04-021	Cladding on Fuel Assembly 5, Row J, Column 4 at 0.53 m above bottom of fuel rod.	3S-27	Qualified.
TE-5J04-039	Cladding on Fuel Assembly 5, Row J, Column 4 at 0.99 m above bottom of fuel rod.	3S-27	Qualified.

TABLE 3-1. (continued)

<u>Variable, System, and Detector</u>	<u>Location</u>	<u>Figure Number</u>	<u>Comments</u>
TEMPERATURE (continued)			
<u>Reactor Vessel</u> (continued)			
TE-5J04-054	Cladding on Fuel Assembly 5, Row J, Column 4 at 1.37 m above bottom of fuel rod.	3S-27	Qualified.
TE-5J08-026	Cladding on Fuel Assembly 5, Row J, Column 8 at 0.66 m above bottom of fuel rod.	3L-46	Qualified.
TE-5LP-001	Fuel Assembly 5, lower end box.	3S-28	Qualified.
TE-5LP-002	Fuel Assembly 5, lower end box.	3S-28	Qualified.
TE-5L08-011	Guide tube for Fuel Assembly 5, Row L, Column 8 at 0.28 m above bottom of guide tube.	3L-47	Qualified.
TE-5L08-024	Guide tube for Fuel Assembly 5, Row L, Column 8 at 0.61 m above bottom of guide tube.	3L-47	Qualified.
TE-5L08-039	Guide tube for Fuel Assembly 5, Row L, Column 8 at 0.99 m above bottom of guide tube.	3L-47	Qualified.
TE-5L08-045	Guide tube for Fuel Assembly 5, Row L, Column 8 at 1.14 m above bottom of guide tube.	3L-47	Qualified.
TE-5UP-010	Fuel Assembly 5, upper end box.	3S-24	Qualified.
TE-6G14-011	Cladding on Fuel Assembly 6, Row G, Column 14 at 0.28 m above bottom of fuel rod.	3S-29	Qualified.

TABLE 3-1. (continued)

Variable, System, and Detector	Location	Figure Number	Comments
TEMPERATURE (continued)			
<u>Reactor Vessel</u> (continued)			
TE-6G14-030	Cladding on Fuel Assembly 6, Row G, Column 14 at 0.76 m above bottom of fuel rod.	3S-29	Qualified.
TE-6G14-045	Cladding on Fuel Assembly 6, Row G, Column 14 at 1.14 m above bottom of fuel rod.	3S-29	Qualified.
TF-5F08-26	Pellet surface at Fuel Assembly 5, Row F, Column 8 at 0.66 m above bottom of fuel rod.	3L-44	Qualified.
TF-5F12-26	Pellet surface at Fuel Assembly 5, Row F, Column 12 at 0.66 m above bottom of fuel rod.	3S-30	Qualified.
TF-5H10-26	Pellet surface at Fuel Assembly 5, Row H, Column 10 at 0.66 m above bottom of fuel rod.	3S-30	Qualified.
TF-5I10-26	Pellet surface at Fuel Assembly 5, Row I, Column 10 at 0.66 m above bottom of fuel rod.	3S-30	Qualified.
TF-5J08-26	Pellet surface at Fuel Assembly 5, Row J, Column 8 at 0.66 m above bottom of fuel rod.	3L-46	Qualified.
TP-5C09	Plenum of fuel rod at Row C, Column 9 of Fuel Assembly 5.	3S-31	Qualified.
TP-5F09	Plenum of fuel rod at Row F, Column 9 of Fuel Assembly 5.	3L-48	Qualified.

TABLE 3-1. (continued)

<u>Variable, System, and Detector</u>	<u>Location</u>	<u>Figure Number</u>	<u>Comments</u>
TEMPERATURE (continued)			
<u>Reactor Vessel</u> (continued)			
TP-5H02	Plenum of fuel rod at Row H, Column 2 of Fuel Assembly 5.	3L-48	Qualified.
TP-5I04	Plenum of fuel rod at Row I, Column 4 of Fuel Assembly 5.	3S-31	Qualified.
TP-5I14	Plenum of fuel rod at Row I, Column 14 of Fuel Assembly 5.	3S-31	Qualified.
TP-5J09	Plenum of fuel rod at Row J, Column 9 of Fuel Assembly 5.	3L-48	Qualified.
TP-5L07	Plenum of fuel rod at Row L, Column 7 of Fuel Assembly 5.	3S-31	Qualified.
<u>Intact Loop</u>			
TT-P139-032	Hot leg primary coolant, Channel A.	3L-49	Qualified.
TT-P139-033	Hot leg primary coolant, Channel E.	3L-49	Qualified.
TT-P139-034	Hot leg primary coolant, Channel C.	3L-49	Qualified.

TABLE 3-2. COMPUTED VARIABLES FOR EXPERIMENT L9-3

Variable, Location, and Detector	Units	Uncertainty	Calculation Method	Figure	Comments
LIQUID LEVEL					
<u>Pressurizer</u>					
PdT-P139-7 } PE-PC-4 } TE-P139-19 } TE-P139-20 }	LEPdT-P139-7	m	±0.06		
			Liquid level was calculated from the pressure balance for the dP cell: $\Delta P = \rho_R gH - \rho_L gL - \rho_V (H - L)$	3C-2 3C-5 3U-3	Qualified, uncertainty is 0.1 m from 0 to 150 s.
			where ΔP = the differential pressure measured (Pa) ρ_R = the liquid density in the reference leg (988 kg/m ³) g = the gravitational acceleration of 9.8 m/s ² H = the liquid height of the reference leg (1.79 m) (leg is assumed to be full) ρ_L = the liquid density in the pipe or vessel (kg/m ³) ρ_V = the vapor density in the pipe or vessel L = the liquid level to be calculated (m). Using the liquid temperature from the TE measurement or the system pressure from the PE, depending on whether the liquid being measured is subcooled or saturated, respectively, the steam tables were consulted to give the specific volume of the liquid which, in turn, provided the ρ_L value. Using the system pressure, again the steam tables were consulted to get the ρ_V value.		
DENSITY COMPENSATED LIQUID LEVEL					
<u>Steam Generator</u>					
LT-P004-008B } PE-SGS-001 }	LTD-P004-008B	m	±0.13		
			The measured liquid level was generated using the steady-state assumption that fluid densities are not changing in time. To convert the indicated level to the actual liquid level, a density compensation must be made. The ΔP measured by the transducer was calculated from the following pressure balance:	3C-3 3U-4	Qualified.

TABLE 3-2. (continued)

Variable, Location, and Detector	Units	Uncertainty	Calculation Method	Figure	Comments
DENSITY COMPENSATED LIQUID LEVEL (continued)			$\Delta P = \rho_R g H - \rho_{1s} g l - \rho_{vs} g (H - l + C)$ where ΔP = the differential pressure measured (Pa) ρ_R = the liquid density in the reference leg (kg/m^3) g = the gravitational acceleration of 9.8 m/s^2 H = the liquid height of the reference leg (4.15 m) (leg is assumed to be full) ρ_{1s} = steady-state liquid density (kg/m^3) ρ_{vs} = steady-state vapor density (kg/m^3) l = indicated liquid level (m) C = height from lower tap to zero level point (2.71 m). The actual liquid level was calculated by rearranging the above equation and substituting in the ΔP and liquid and vapor densities: $L = (\Delta P + \rho_v g H - \rho_R g H) / (\rho_{vs} - \rho_{1s}) - C$ where ρ_1 = actual liquid density (kg/m^3) ρ_v = actual vapor density (kg/m^3) L = actual liquid level (m). Actual densities were obtained from saturated steam tables using a pressure measurement in the pressurizer and steam generator and a temperature measurement in the blowdown suppression tank.		
Steam Generator (continued)					
MASS FLOW RATE					
Pressure Relief Line					
DE-PC-S03A } FE-PC-S02 } FR-PC-S231	kg/s	±0.5	FR-PC-S231 was calculated using densitometer and turbine meter data. The following equation was applied:	3C-1 3U-2	Qualified.

TABLE 3-2. (continued)

Variable, Location, and Detector	Units	Uncertainty	Calculation Method	Figure	Comments
MASS FLOW RATE (continued)			Flow rate (kg/s) = [Density (kg/m ³)] * [Fluid velocity (m/s)] * [Flow area (m ²)] * [1000 (kg/Mg)].		
Pressure Relief Line (continued)					
DE-PC-S03A } MF-PC-S02 } FR-PC-S232	kg/s	±0.5	FR-PC-S232 was calculated using densitometer and drag screen data. The momentum flux was forced to zero when its value was <0.1 Mg/m ² s ² . The following equation was then applied. Flow rate (kg/s) = (sign of momentum flux) * $\sqrt{\frac{[\text{Momentum flux (Mg/m}^2\text{s}^2)]}{[\text{Density (Mg/m}^3)]}} * [\text{Flow area (m}^2)] * [1000 \text{ (kg/Mg)}].$ Pressure relief line flow area = 0.0006818 m ² .	3C-4	Qualified.
FLUID SUBCOOLING					
Upper Plenum					
TE-SUP-3 } TE-SUP-4 } TE-SUP-10 } TE-SUP-11 } TE-SUP-13 } TE-SUP-14 } TE-SUP-15 } PE-1UP-1A } PE-1UP-1A1 }	SC-SUP-202	K 26	The subcooling is defined as T _{sat} - T. The saturation temperature was calculated from an average pressure reading from PE-1UP-1A and PE-1UP-1A1 using the following curve fits of steam table data: 1. For P < 1.4 MPa, T _{sat} = 348.225 + 290.13P - 399.543P ² + 298.730P ³ - 84.196P ⁴ 2. For 1.4 MPa ≤ P ≤ 12 MPa, T _{sat} = 419.024 + 42.6705P - 5.63957P ² + 0.433108P ³ - 0.0130329P ⁴ 3. For P > 12 MPa, T _{sat} = 580.252 + 8.84806P - 0.114572P ² . The measured temperature is an average of the seven listed temperature measurements.	3C-6	Qualified.

Short-Term Plots (-50 to 200 s)

EXPERIMENT L9-3

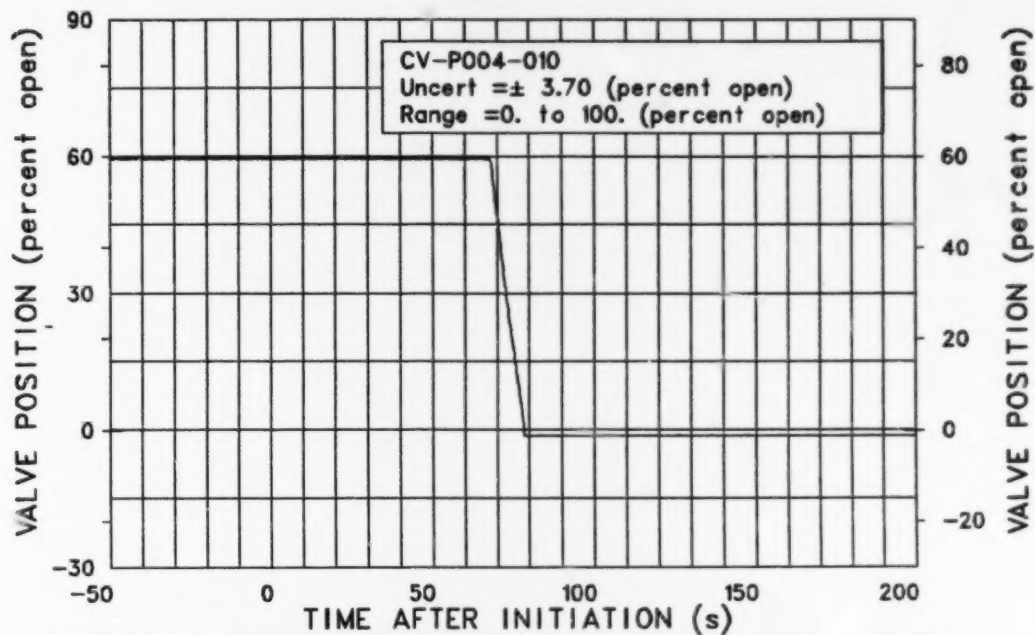


Figure 3S-1. Valve position for secondary coolant system steam flow control valve (CV-P004-010) (qualified, no other measurement to verify magnitude).

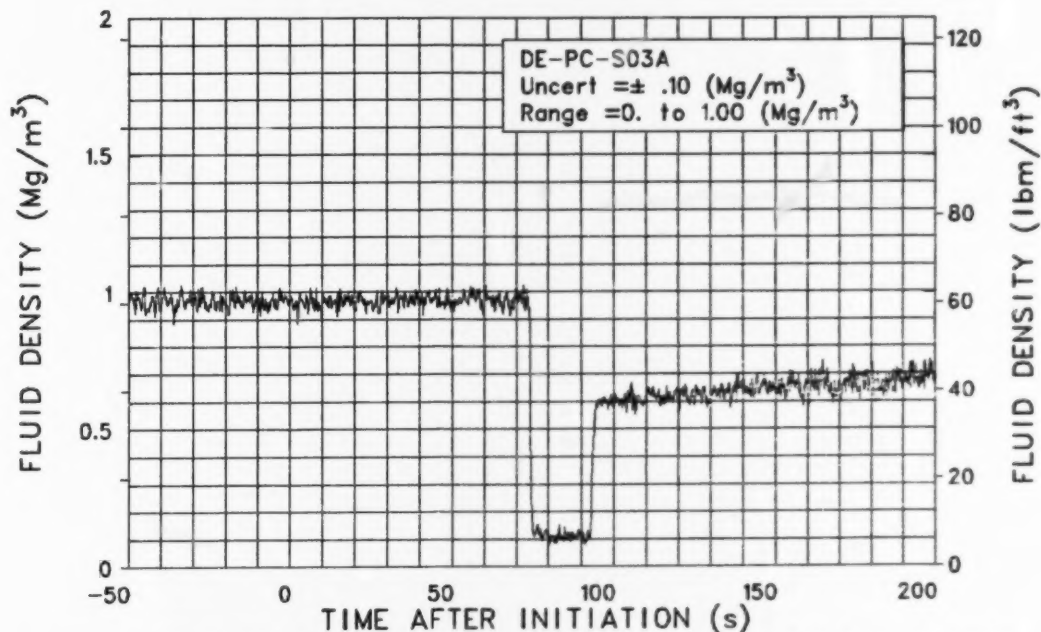


Figure 3S-2. Fluid density in intact loop pressure relief line upstream of experiment relief valve, chordal density (DE-PC-S03A).

EXPERIMENT L9-3

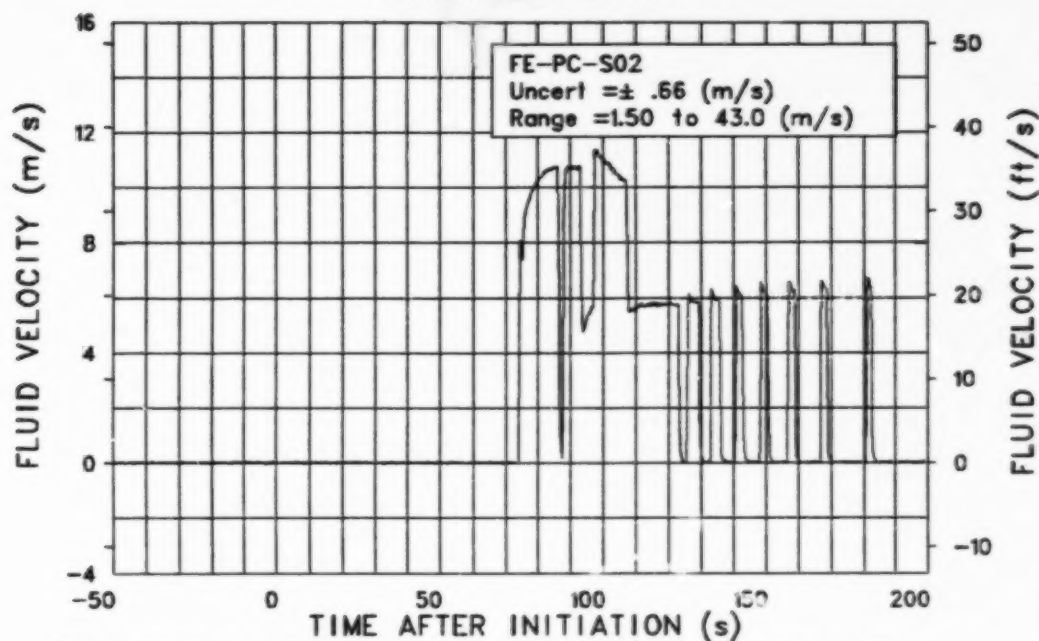


Figure 3S-3. Fluid velocity in intact loop pressure relief line upstream of experiment relief valve (FE-PC-S02).

EXPERIMENT L9-3

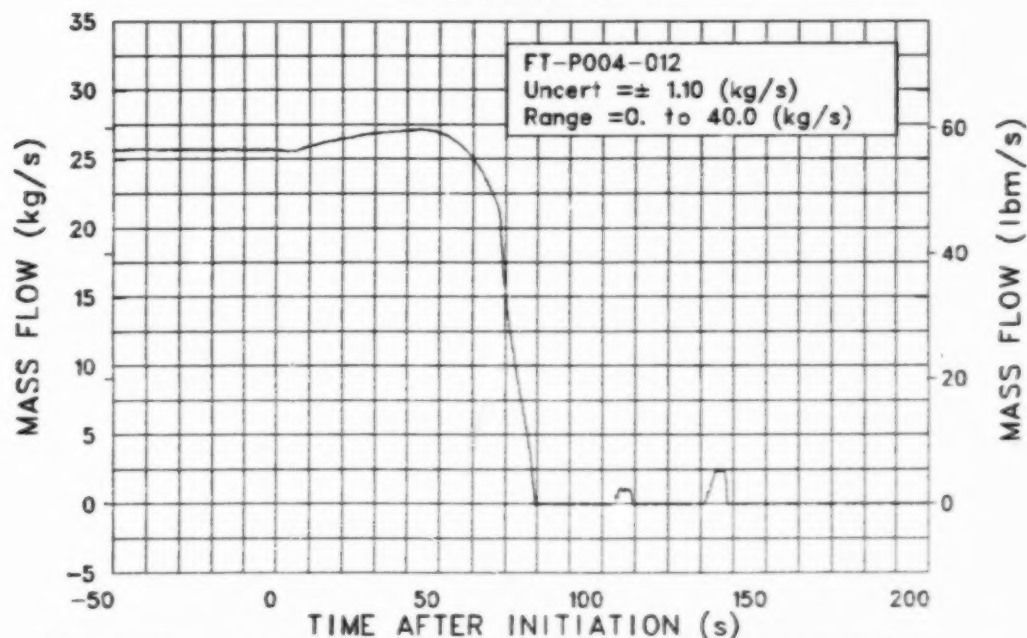


Figure 3S-4. Steam flow rate at condenser inlet (FT-P004-012) (qualified, forced to agree with reactor power at initial conditions).

EXPERIMENT L9-3

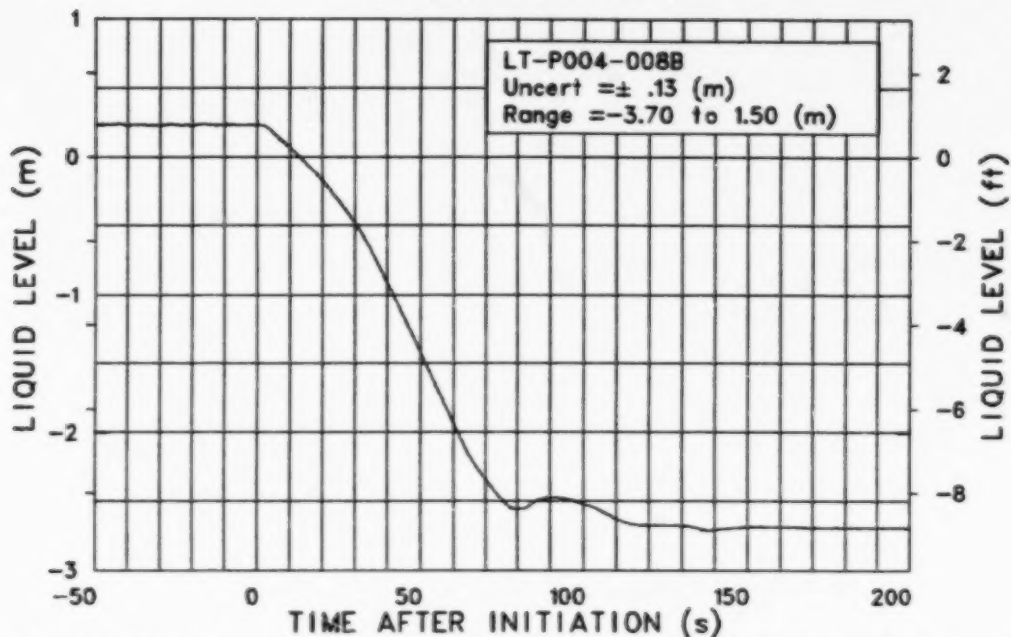


Figure 3S-5. Liquid level in steam generator secondary side, wide range (LT-P004-008B).

EXPERIMENT L9-3

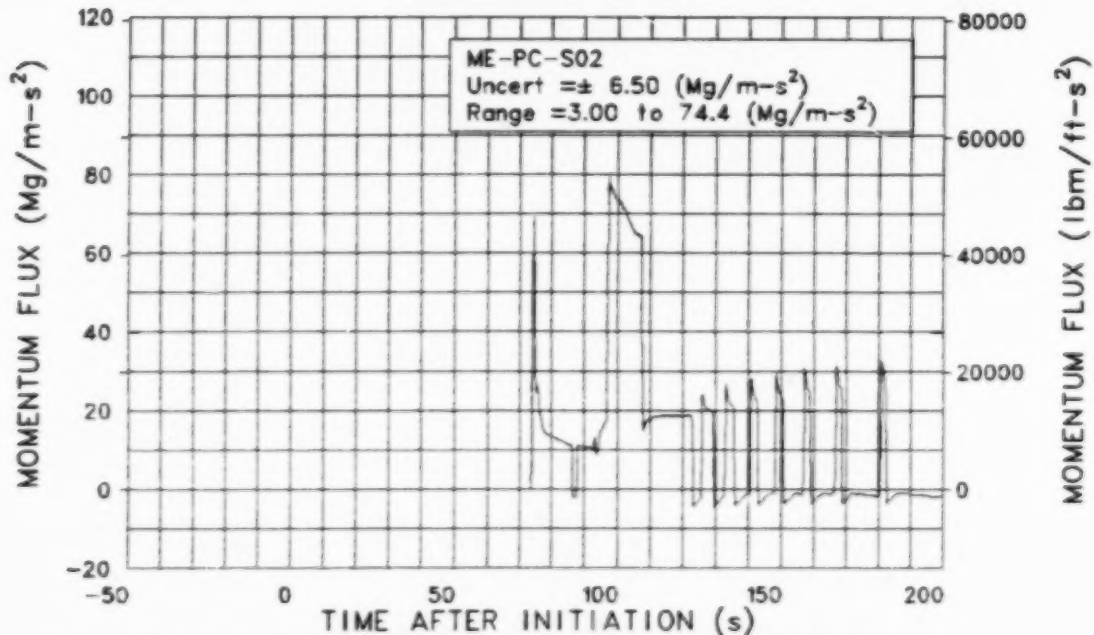


Figure 3S-6. Momentum flux upstream of experiment relief valve (ME-PC-S02) (qualified, shows negative momentum due to unresolvable temperature compensation).

EXPERIMENT L9-3

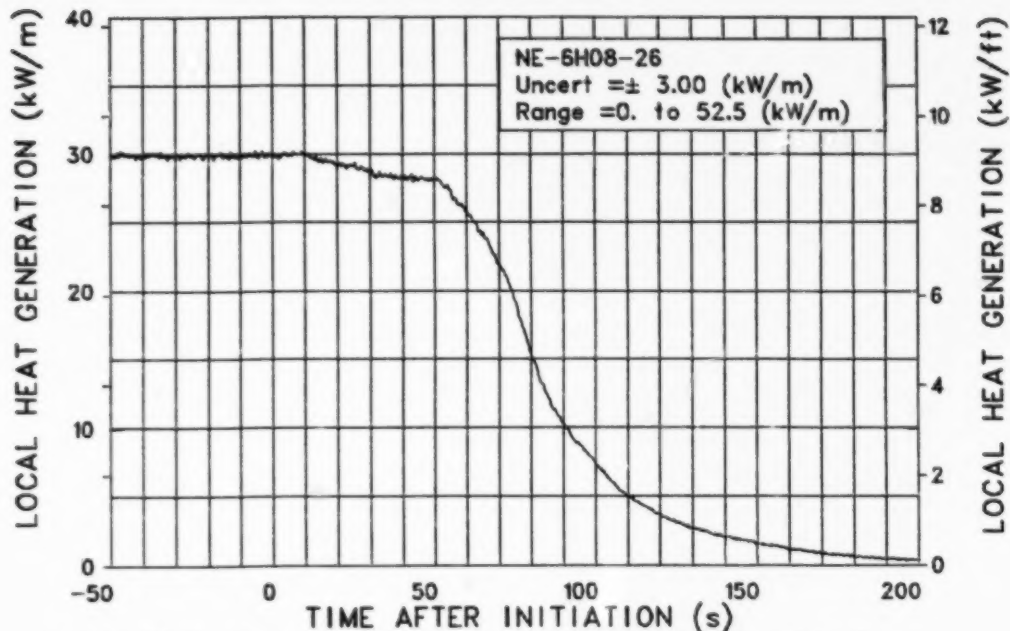


Figure 3S-7. Local heat generation rate for Fuel Assembly 6 (NE-6H08-26).

EXPERIMENT L9-3

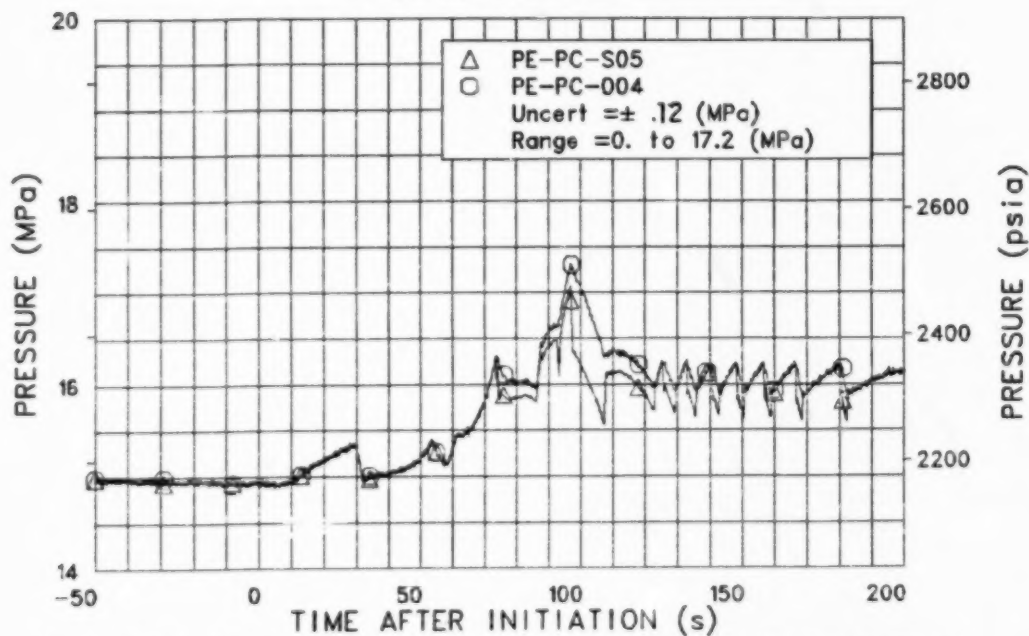


Figure 3S-8. Pressure in intact loop pressure relief line upstream of experiment relief valve and in pressurizer vapor space (PE-PC-S05 and -004).

EXPERIMENT L9-3

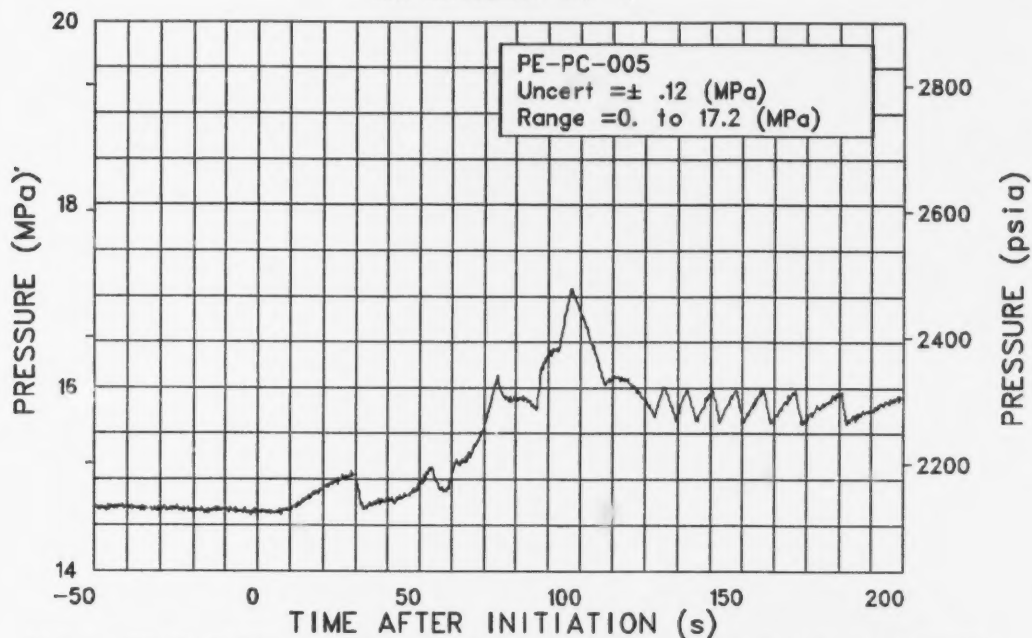


Figure 3S-9. Reference pressure in intact loop between steam generator outlet and primary coolant pump inlet (PE-PC-005).

EXPERIMENT L9-3

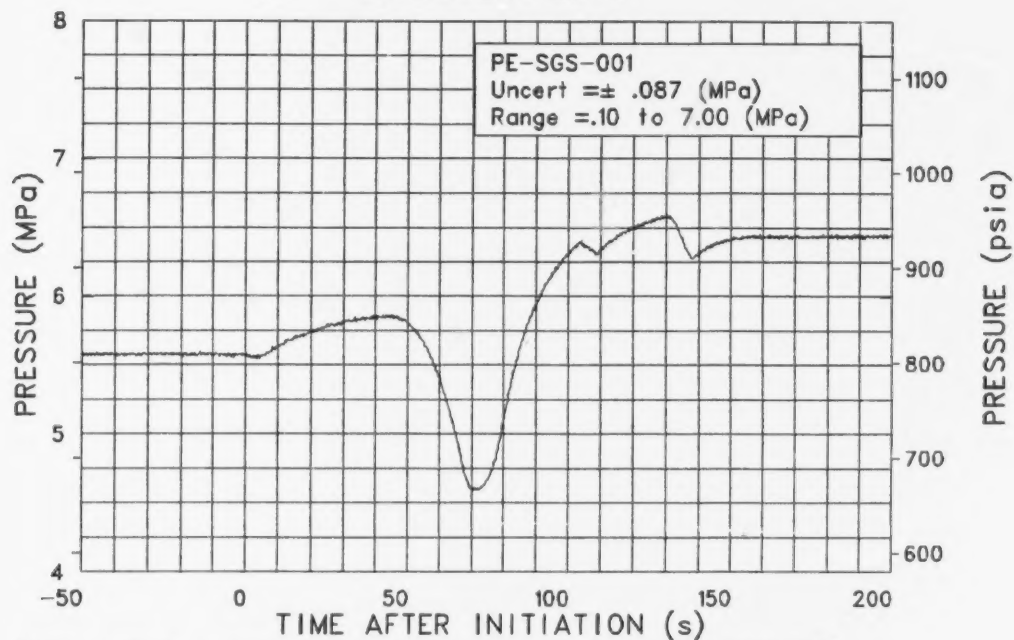


Figure 3S-10. Pressure in steam generator dome (PE-SGS-001).

EXPERIMENT L9-3

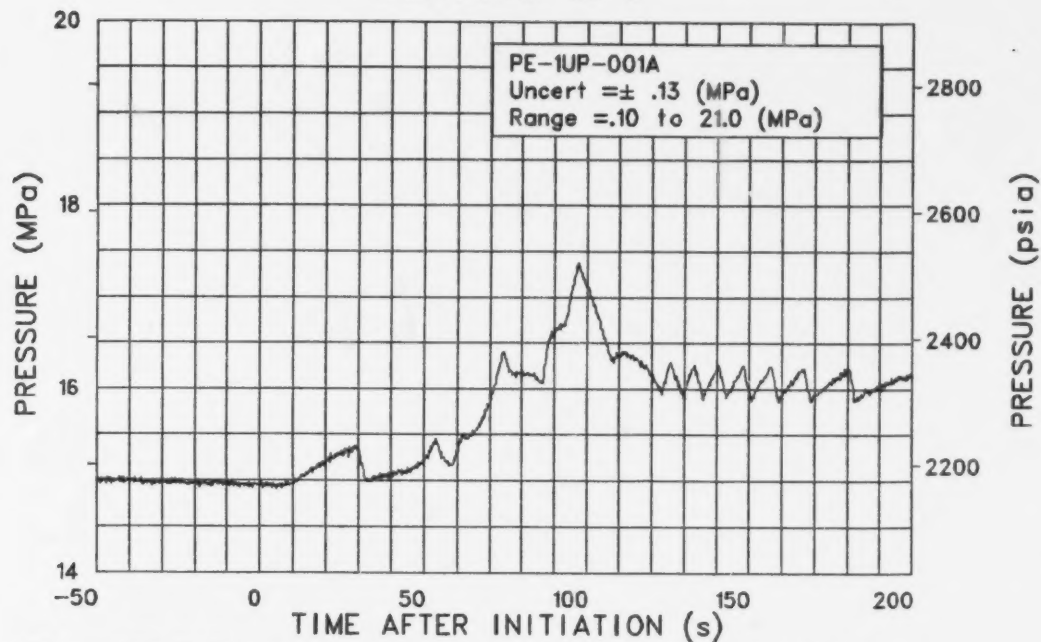


Figure 3S-11. Pressure above upper end box of Fuel Assembly 1 (PE-1UP-001A).

EXPERIMENT L9-3

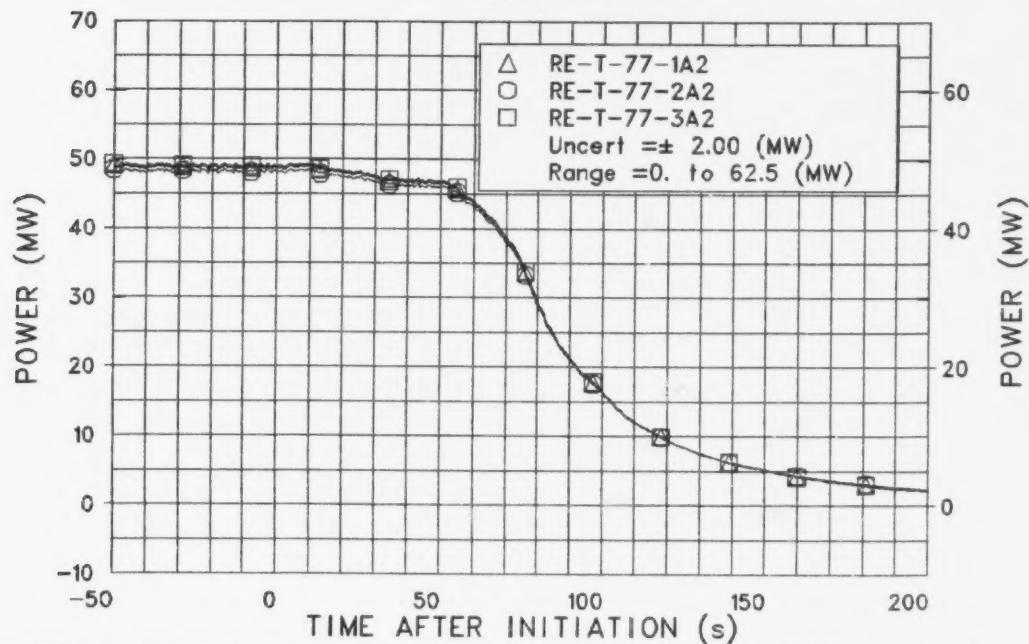


Figure 3S-12. Local average power, Channels A, B, and C (RE-T-77-1A2, -2A2, and -3A2).

EXPERIMENT L9-3

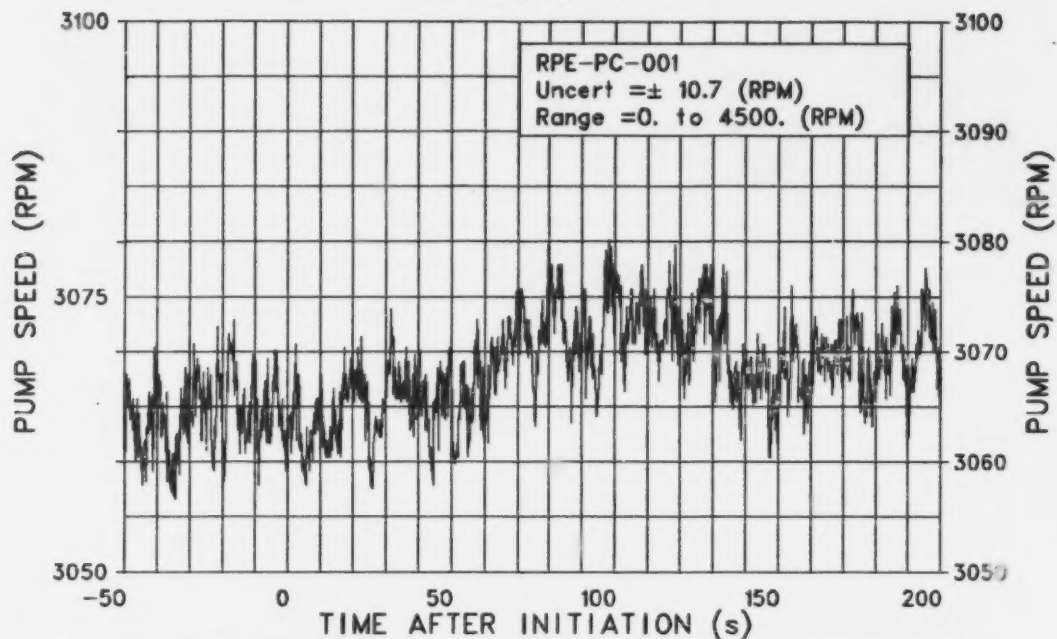


Figure 3S-13. Pump speed for primary coolant Pump 1 (RPE-PC-001).

EXPERIMENT L9-3

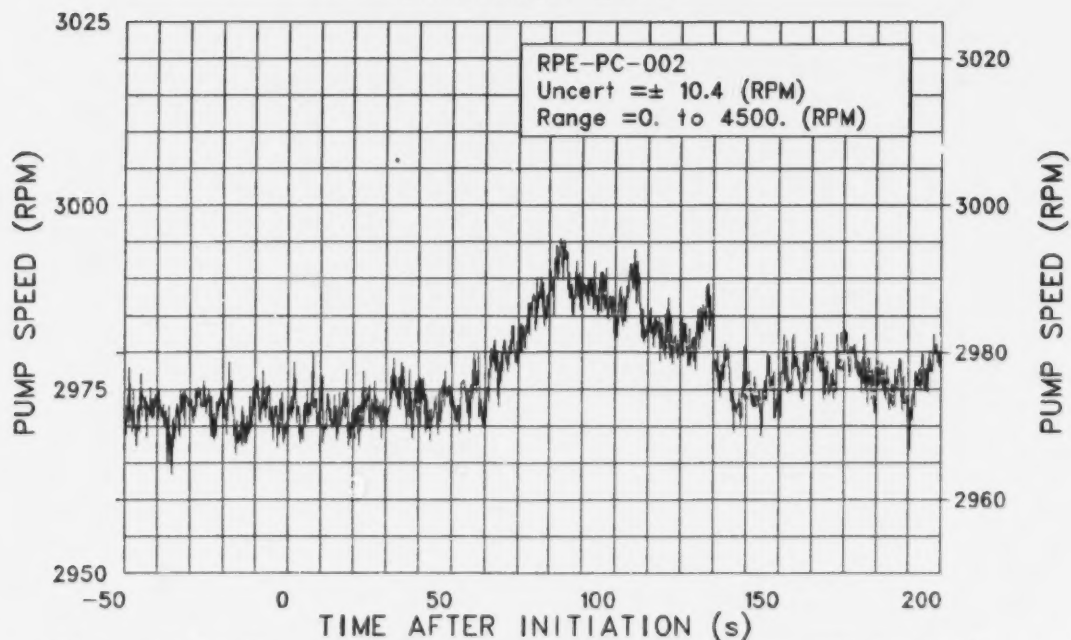


Figure 3S-14. Pump speed for primary coolant Pump 2 (RPE-PC-002).

EXPERIMENT L9-3

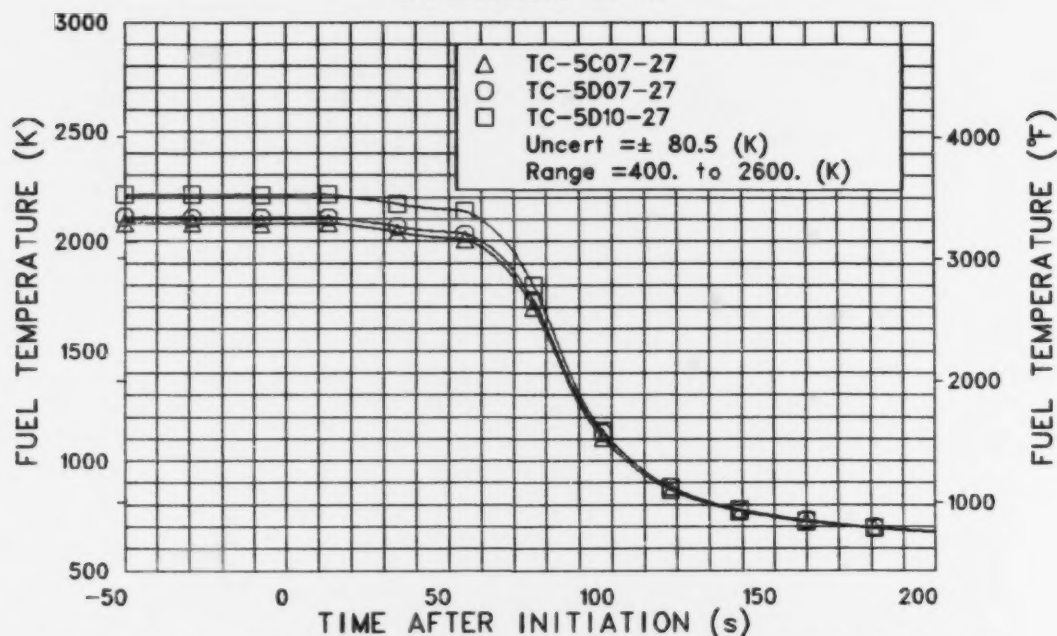


Figure 3S-15. Fuel centerline temperature at Fuel Assembly 5, Rows C and D, Columns 7 and 10 at 0.69 m above bottom of fuel rod (TC-5C07-27, -5D07-27, and -5D10-27).

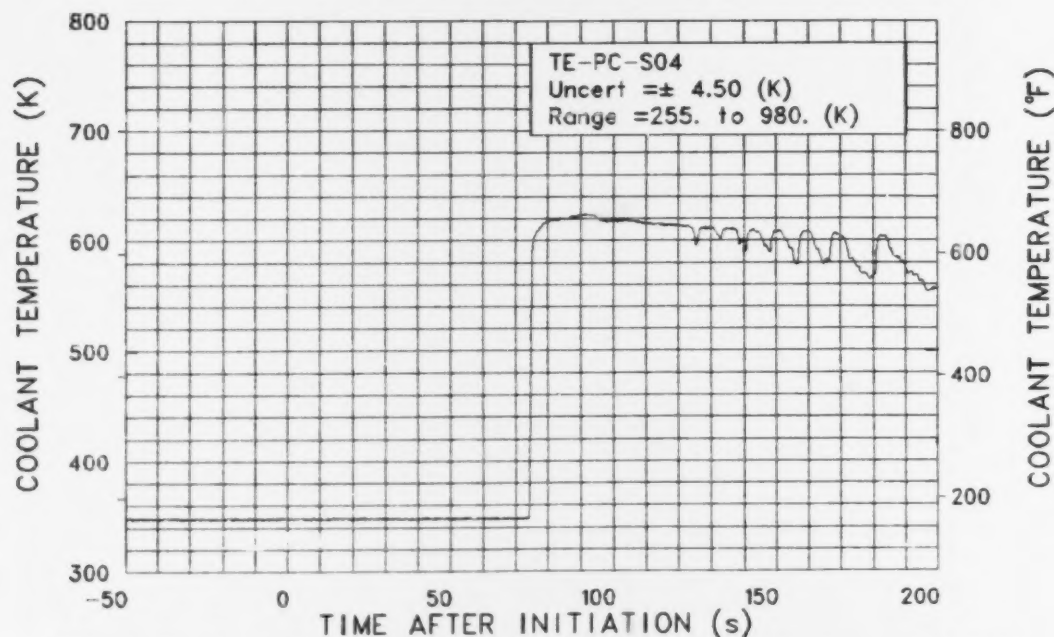


Figure 3S-16. Coolant temperature in intact loop pressure relief line upstream of experiment relief valve (TE-PC-S04).

EXPERIMENT L9-3

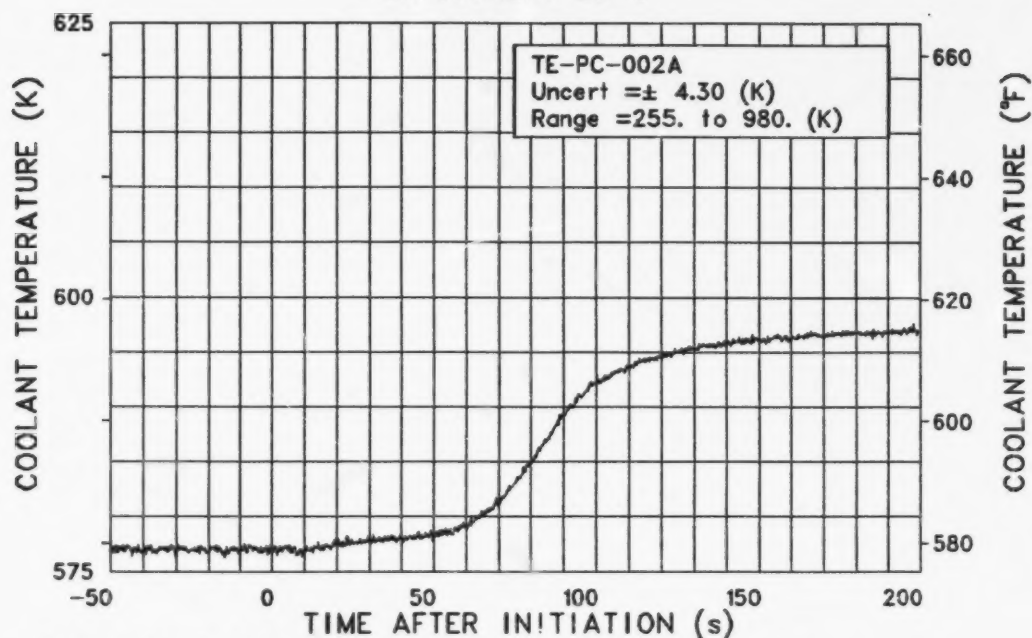


Figure 3S-17. Coolant temperature in intact loop hot leg (TE-PC-002A).

EXPERIMENT L9-3

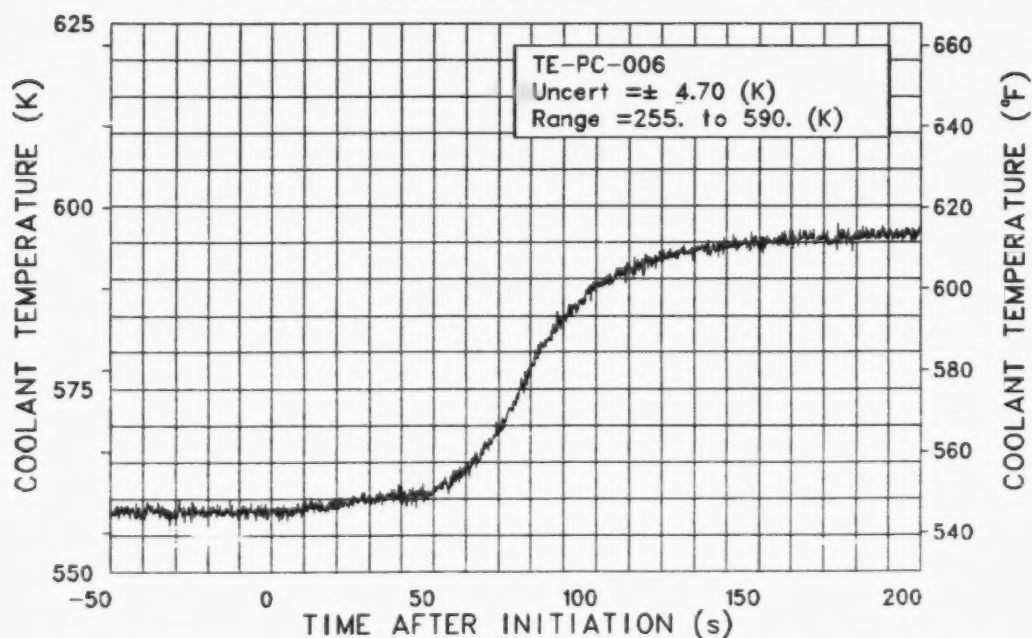


Figure 3S-18. Coolant temperature in intact loop cold leg next to top of ECC Rake 1 (TE-PC-006).

EXPERIMENT L9-3

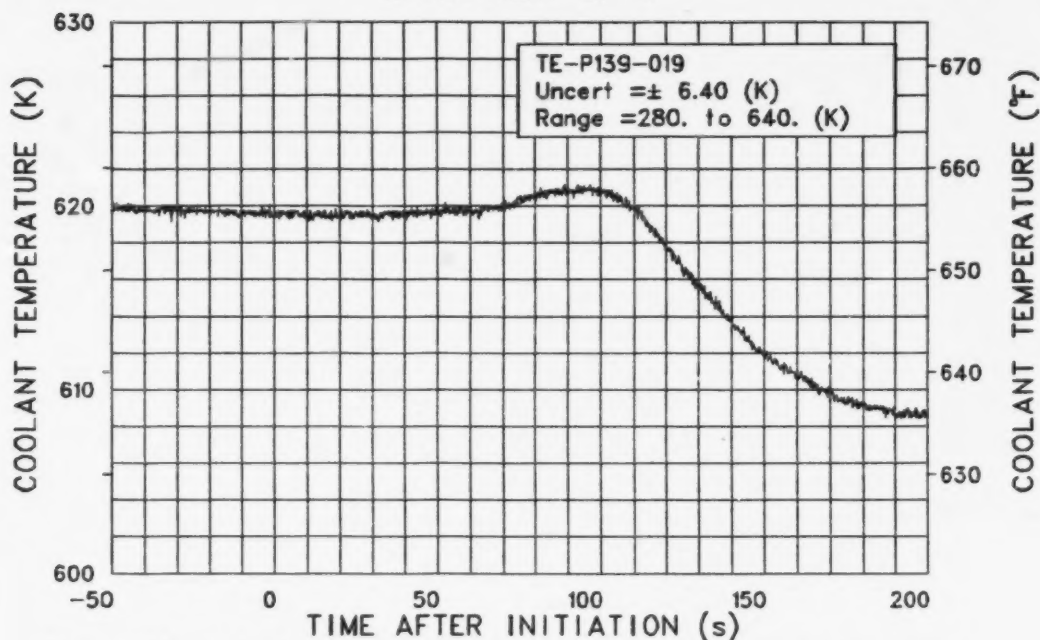


Figure 3S-19. Coolant temperature in intact loop pressurizer vapor space (TE-P139-019).

EXPERIMENT L9-3

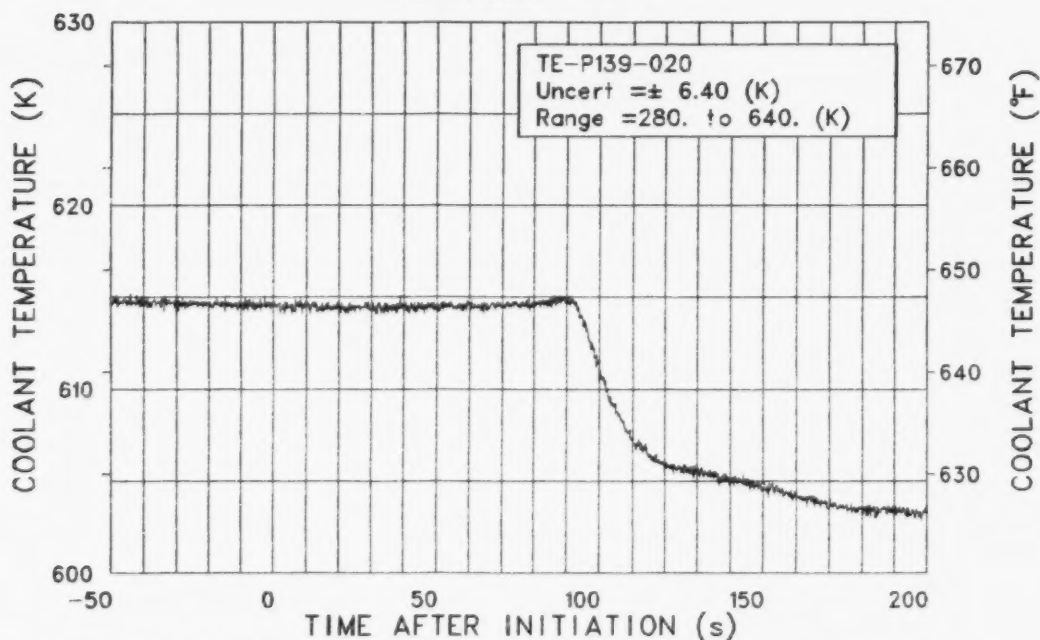


Figure 3S-20. Coolant temperature in intact loop pressurizer liquid space (TE-P139-020).

EXPERIMENT L9-3

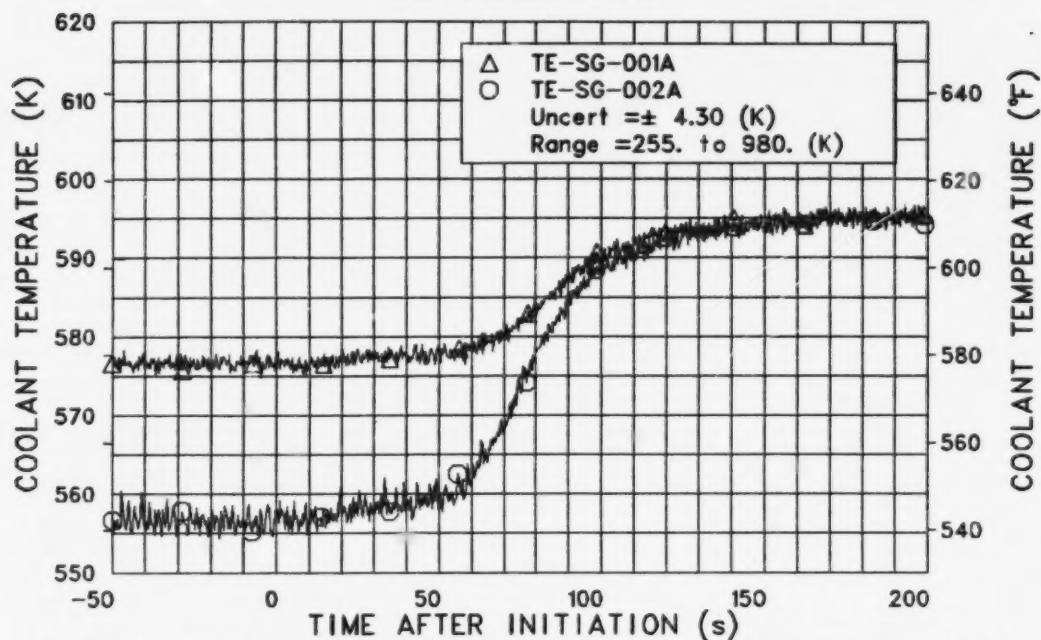


Figure 3S-21. Coolant temperature in intact loop steam generator inlet and outlet plenums (TE-SG-001A and -002A).

EXPERIMENT L9-3

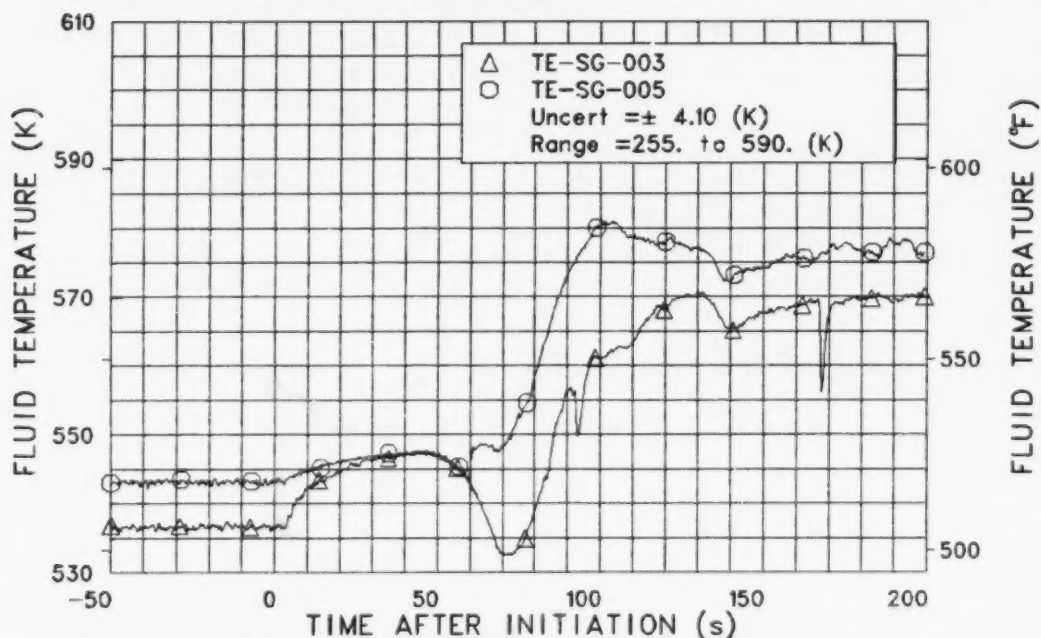


Figure 3S-22. Fluid temperature in steam generator secondary side downcomer at 0.25 and 2.92 m above top of tube sheet (TE-SG-003 and -005.)

EXPERIMENT L9-3

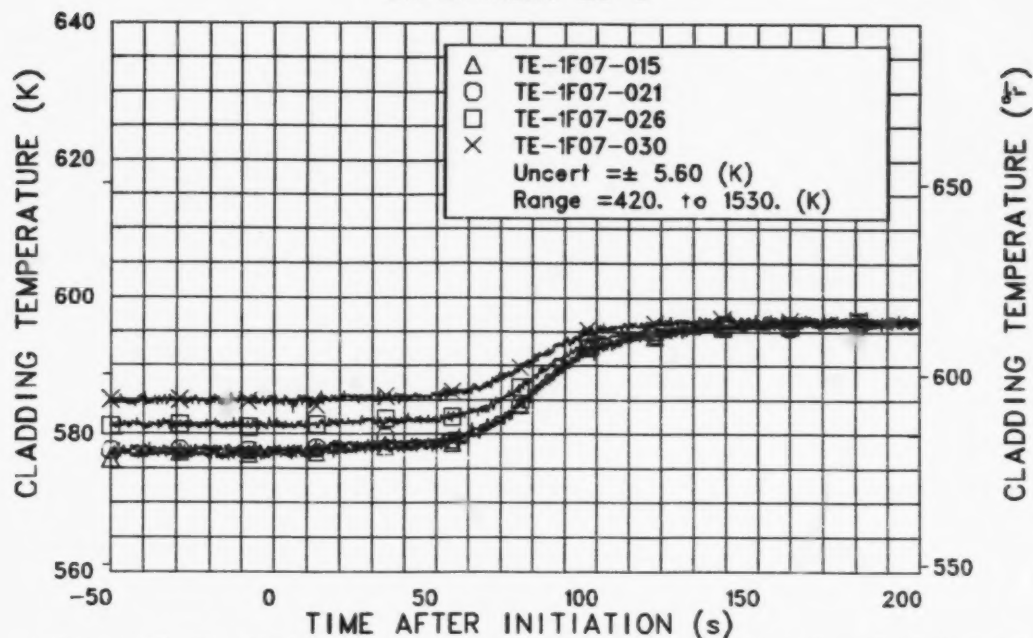


Figure 3S-23. Cladding temperature at Fuel Assembly 1, Row F, Column 7 at 0.38, 0.53, 0.66, and 0.76 m above bottom of fuel rod (TE-1F07-015, -021, -026, and -030).

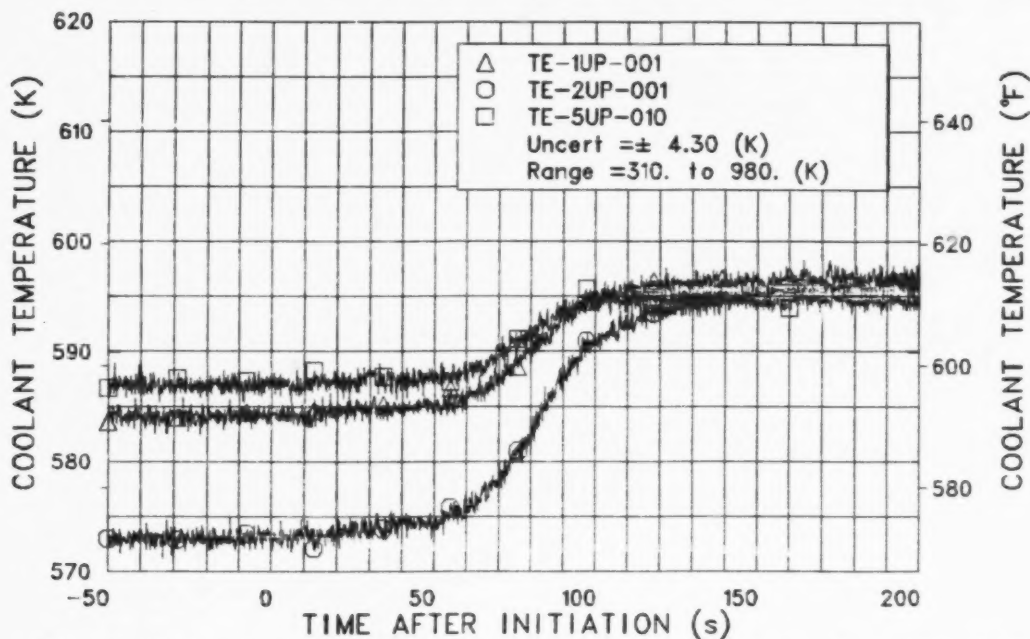


Figure 3S-24. Coolant temperature at upper end boxes of Fuel Assemblies 1, 2, and 5 (TE-1UP-001, -2UP-001, and -5UP-010).

EXPERIMENT L9-3

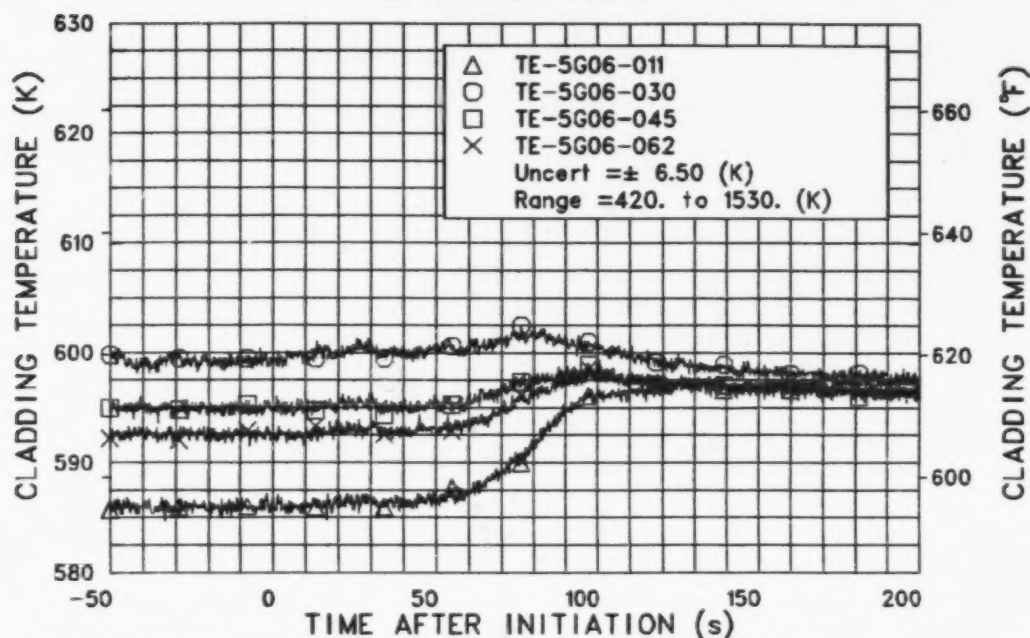


Figure 3S-25. Cladding temperature at Fuel Assembly 5, Row G, Column 6 at 0.28, 0.76, 1.14, and 1.57 m above bottom of fuel rod (TE-5G06-011, -030, -045, and -062).

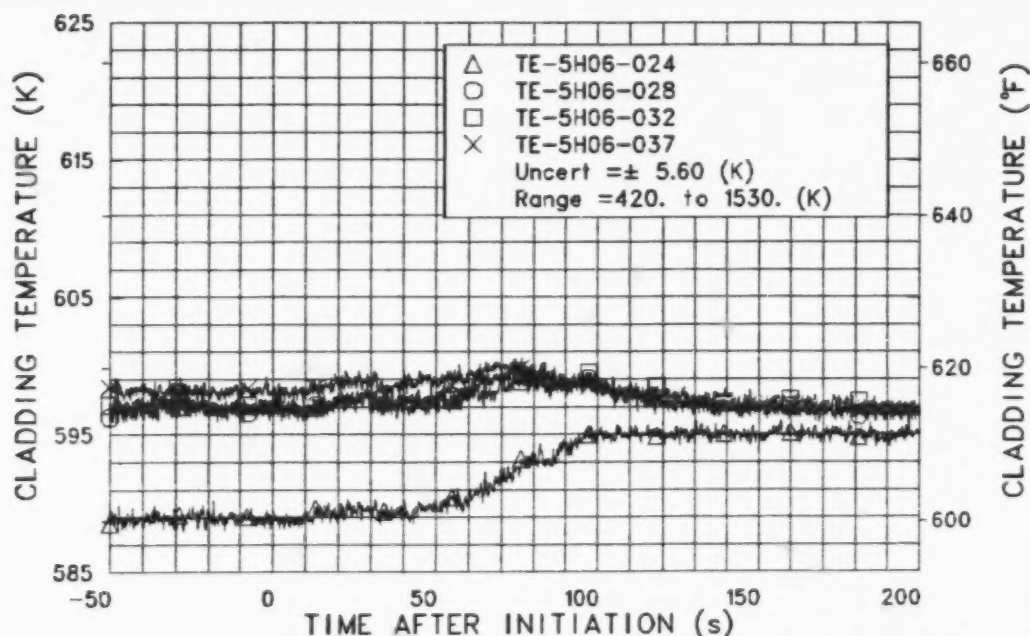


Figure 3S-26. Cladding temperature at Fuel Assembly 5, Row H, Column 6 at 0.61, 0.71, 0.81, and 0.94 m above bottom of fuel rod (TE-5H06-024, -028, -032, and -037).

EXPERIMENT L9-3

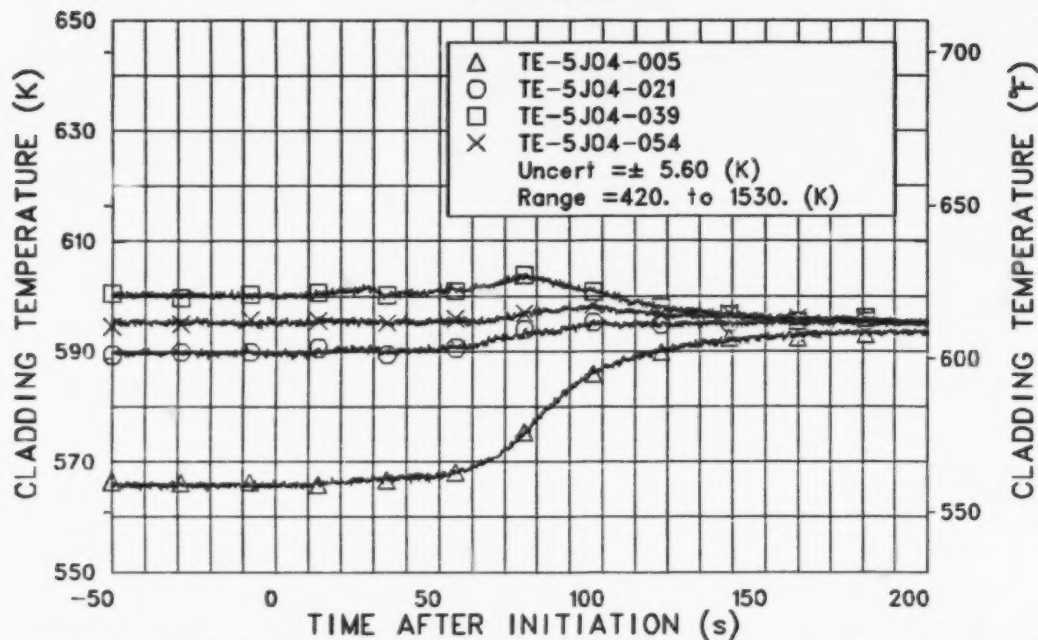


Figure 3S-27. Cladding temperature at Fuel Assembly 5, Row J, Column 4 at 0.13, 0.53, 0.99 and 1.37 m above bottom of fuel rod (TE-5J04-005, -021, -039, and -054).

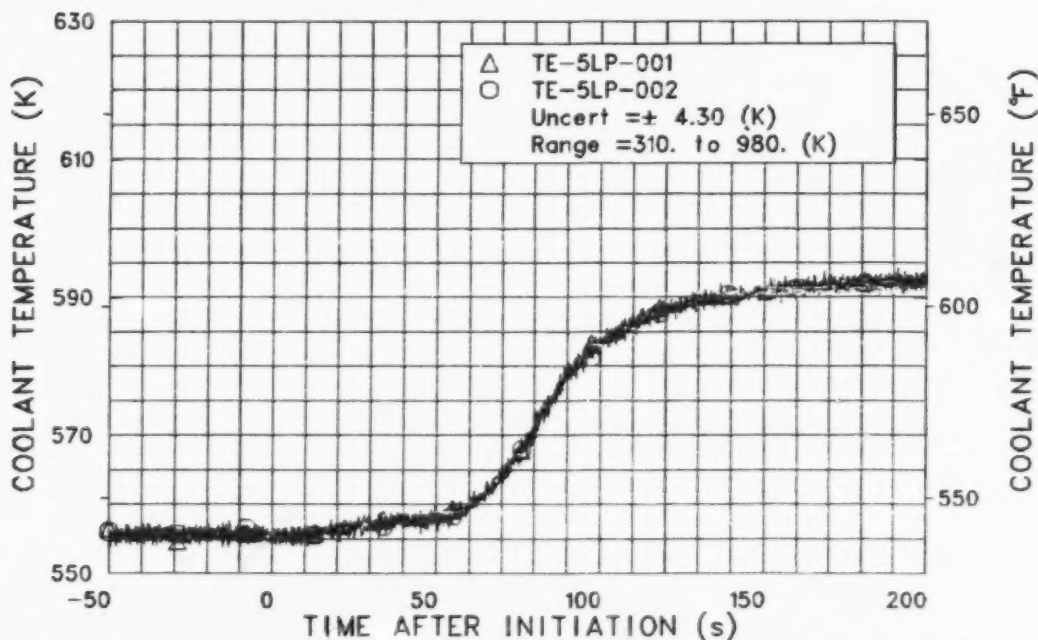


Figure 3S-28. Coolant temperature at lower end box of Fuel Assembly 5 (TE-5LP-001 and -002).

EXPERIMENT L9-3

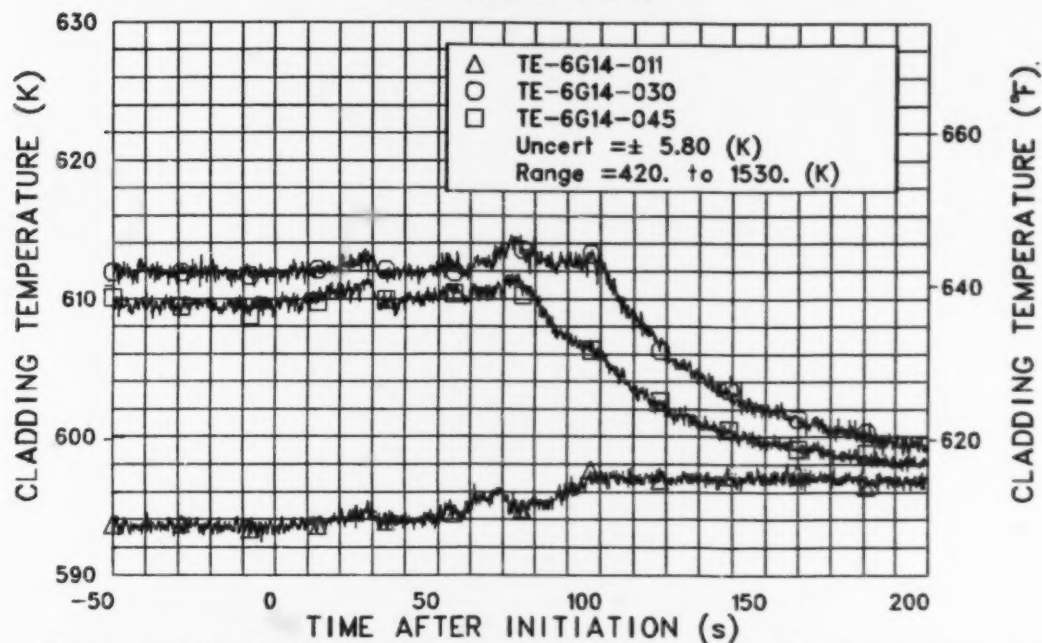


Figure 3S-29. Cladding temperature at Fuel Assembly 6, Row G, Column 14 at 0.28, 0.76, and 1.14 m above bottom of fuel rod (TE-6G14-011, -030, and -045).

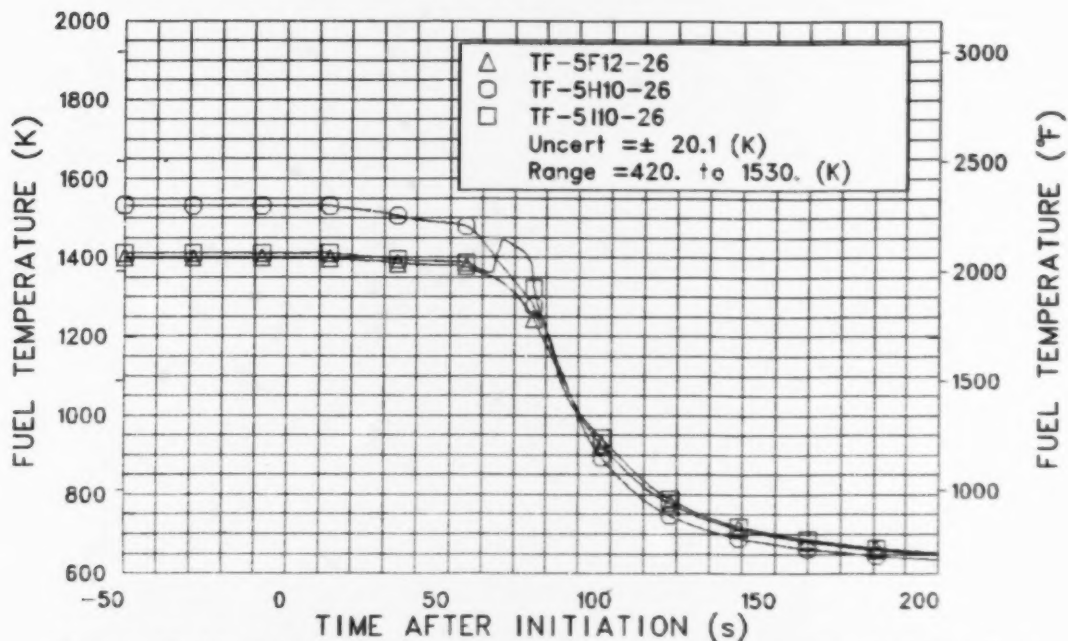


Figure 3S-30. Pellet surface temperature at Fuel Assembly 5, Rows F, H, and I, Columns 10 and 12 at 0.66 m above bottom of fuel rod (TF-5F12-26, -5H10-26, and -5I10-26).

EXPERIMENT L9-3

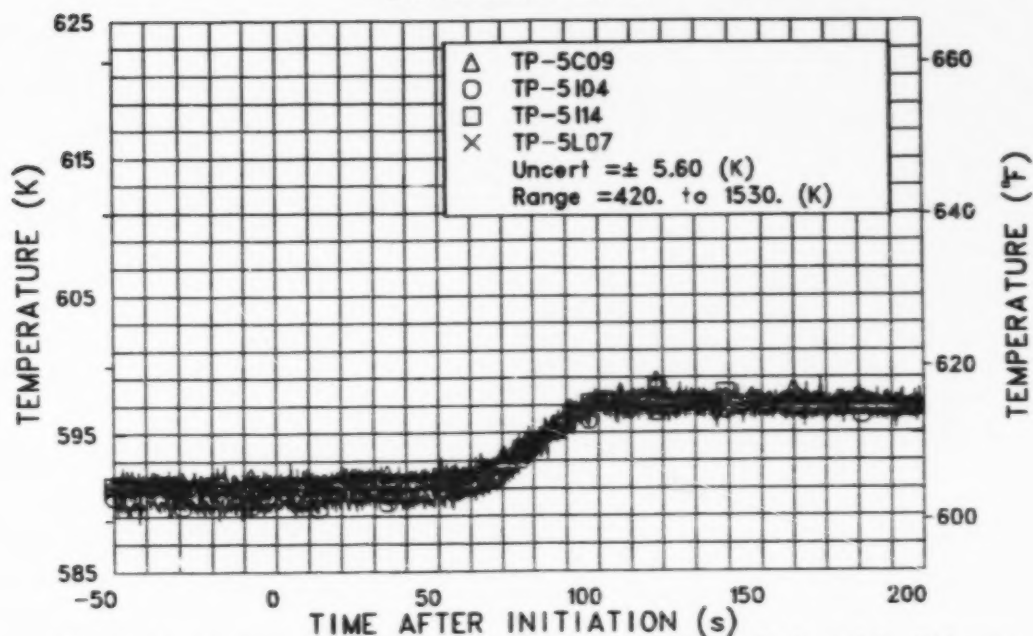


Figure 3S-31. Fuel rod plenum temperature at Rows C, I, and L, Columns 9, 4, 14, and 7 of Fuel Assembly 5 (TP-5C09, -5I04, -5I14, and -5L07).

Long-Term Plots
(0 to 18005)

EXPERIMENT L9-3

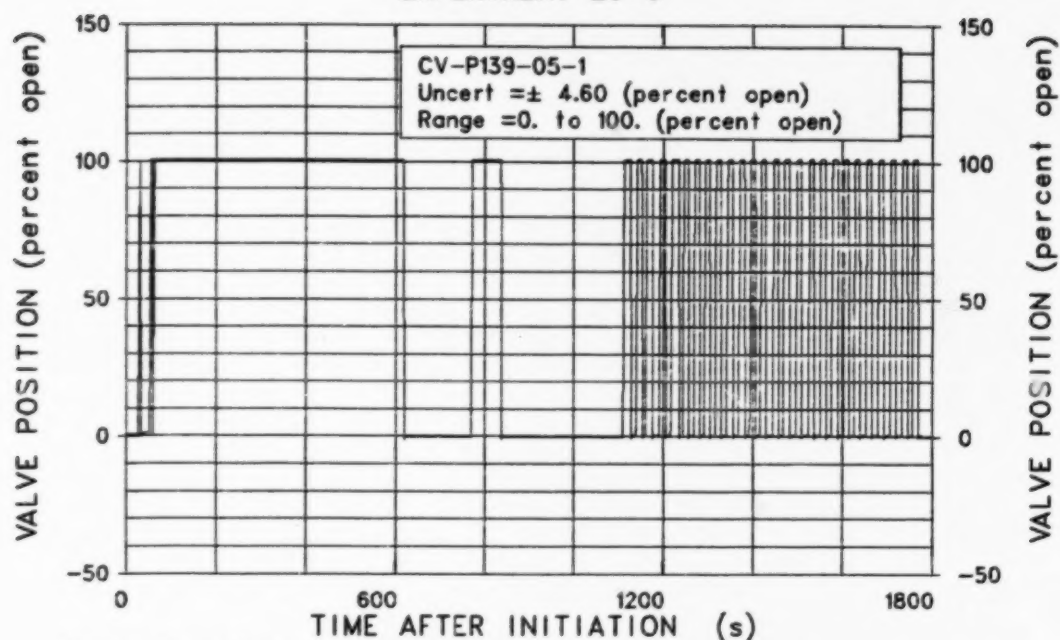


Figure 3L-1. Valve position for pressurizer spray valve (CV-P139-05-1).

EXPERIMENT L9-3

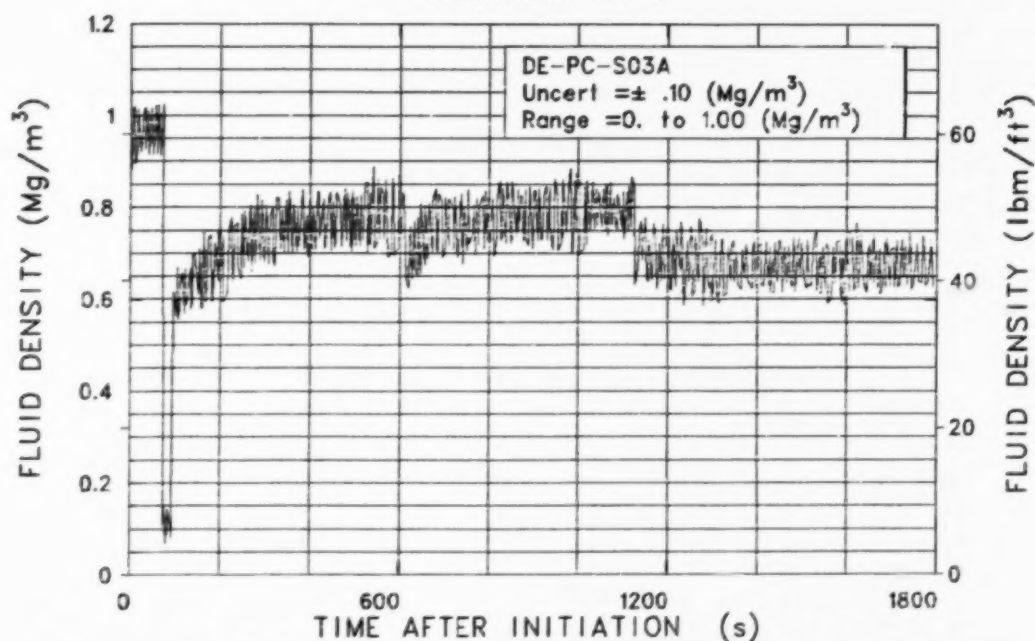


Figure 3L-2. Fluid density in intact loop pressure relief line upstream of experiment relief valve, chordal density (DE-PC-S03A).

EXPERIMENT L9-3

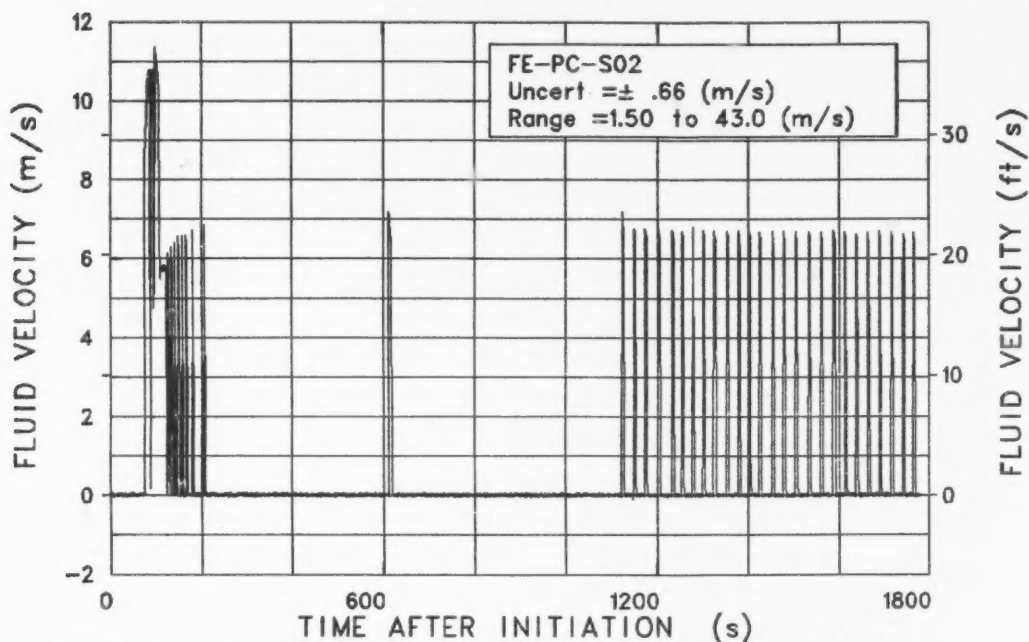


Figure 3L-3. Fluid velocity in intact loop pressure relief line upstream of experiment relief valve (FE-PC-S02).

EXPERIMENT L9-3

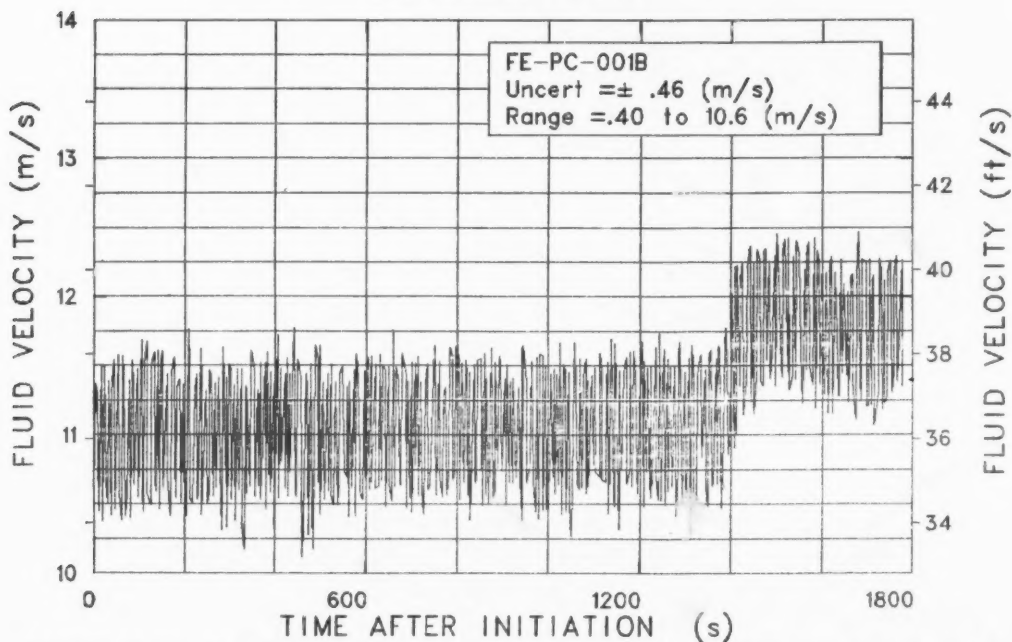


Figure 3L-4. Fluid velocity in intact loop cold leg DTT horizontal rake at center of pipe (FE-PC-001B).

EXPERIMENT L9-3

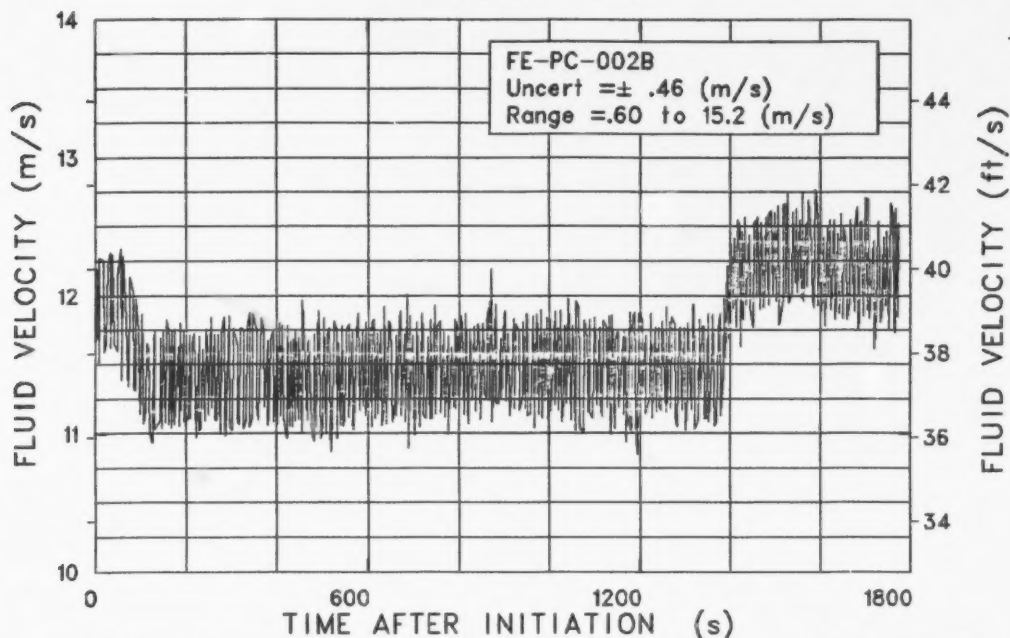


Figure 3L-5. Fluid velocity in intact loop hot leg DTT rake at middle of pipe (FE-PC-002B).

EXPERIMENT L9-3

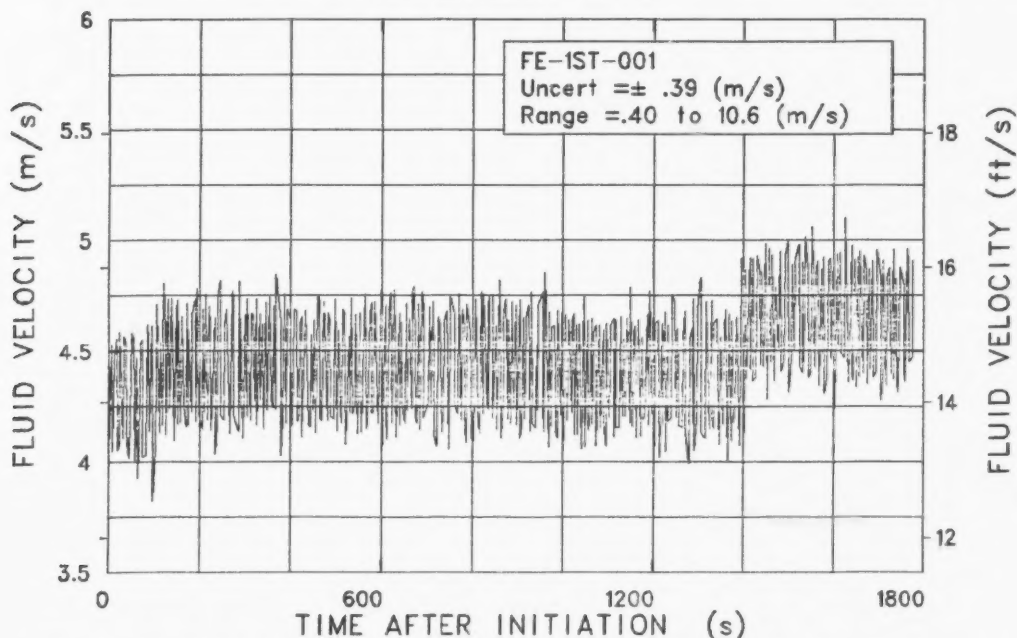


Figure 3L-6. Fluid velocity in reactor vessel Downcomer Stalk 1 (FE-1ST-001) (qualified, normalized to indicate average flow in downcomer).

EXPERIMENT L9-3

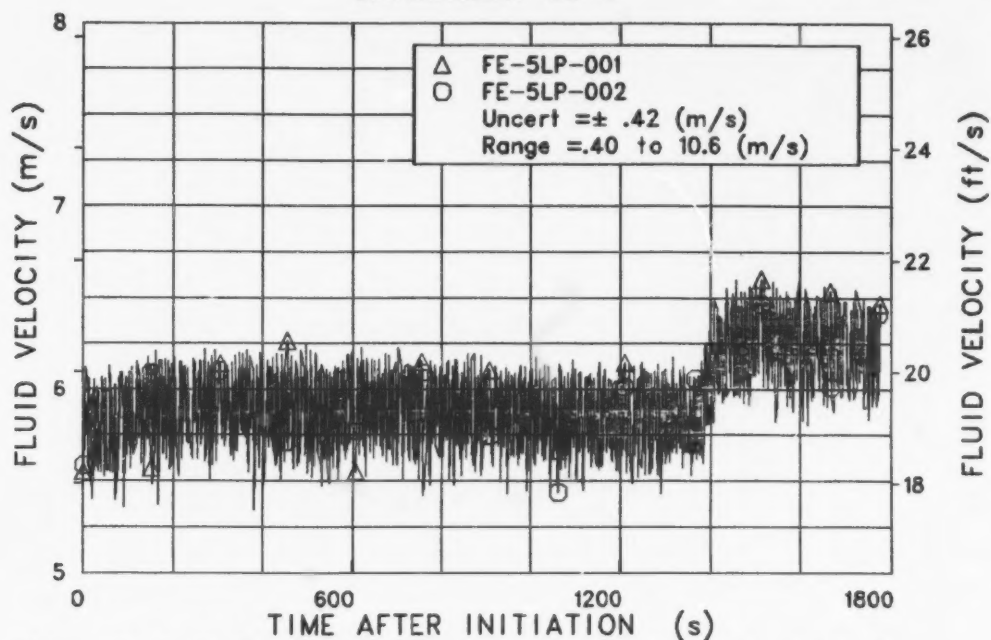


Figure 3L-7. Fluid velocity at lower end box of Fuel Assembly 5 (FE-5LP-001 and -002) (qualified, normalized to indicate average flow in the lower plenum).

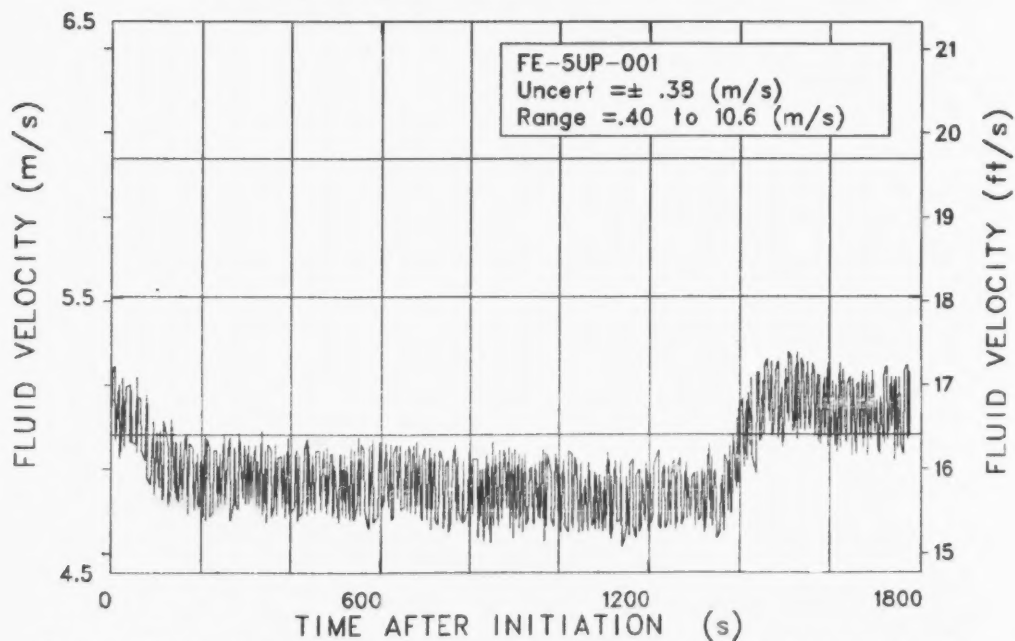


Figure 3L-8. Fluid velocity above upper end box of Fuel Assembly 5 (FE-5UP-001) (qualified, normalized to indicate average flow in the upper plenum).

EXPERIMENT L9-3

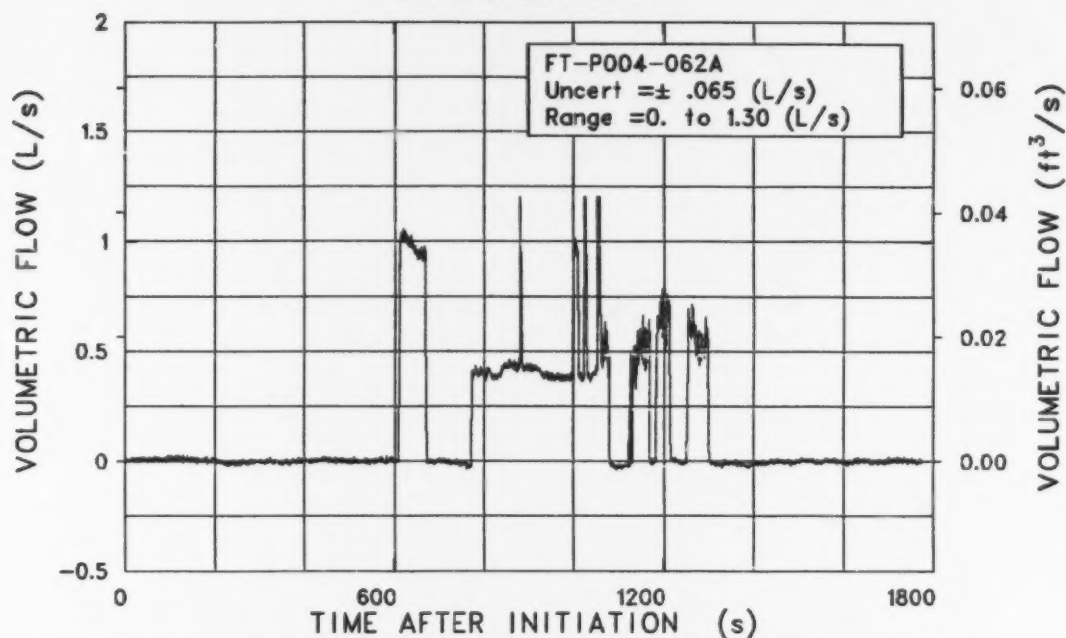


Figure 3L-9. Flow rate in secondary coolant system discharge of auxiliary feedwater and makeup pumps (FT-P004-062A) (qualified to 1080 s, failed thereafter).

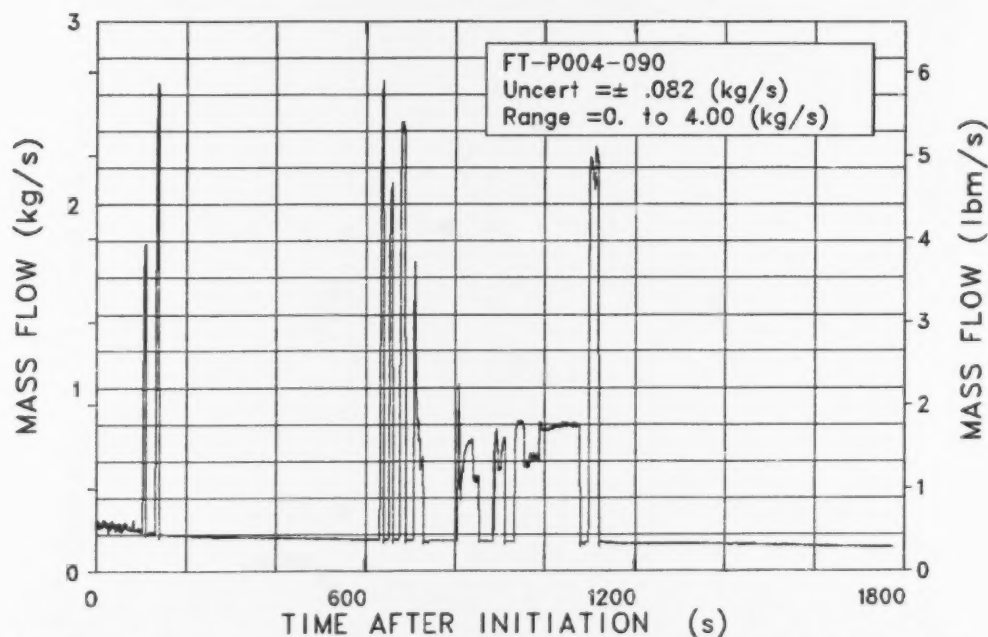


Figure 3L-10. Flow rate in secondary coolant system main steam bypass line (FT-P004-090) (qualified, no other measurement to verify magnitude, possible zero offset drift).

EXPERIMENT L9-3

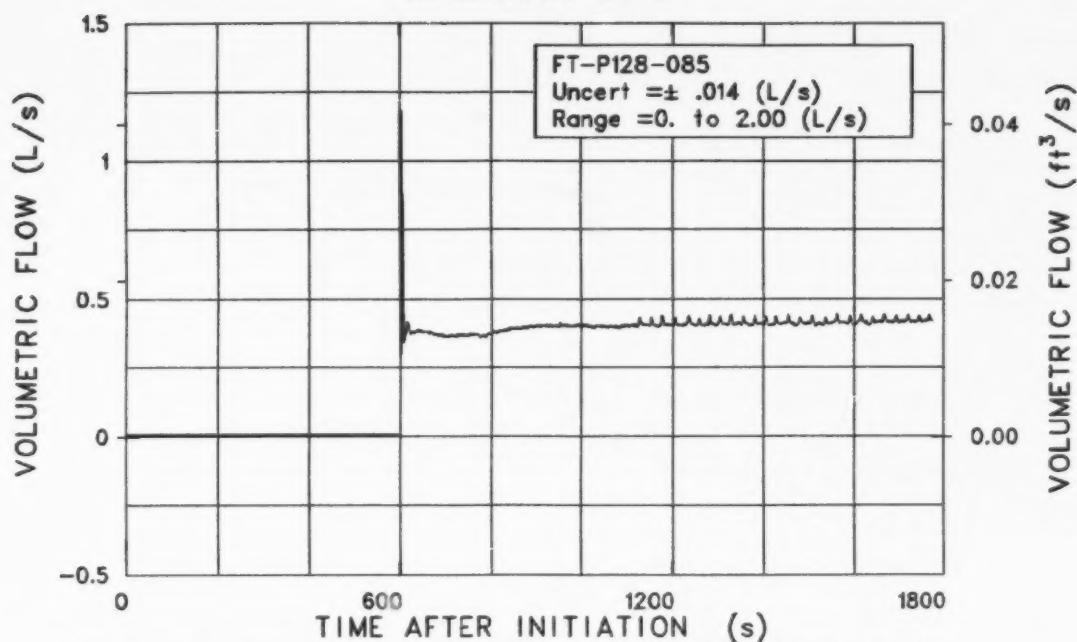


Figure 3L-11. Flow rate in HPIS Pump B discharge (FT-P128-085)
 (qualified, no other measurement for direct comparison).

EXPERIMENT L9-3

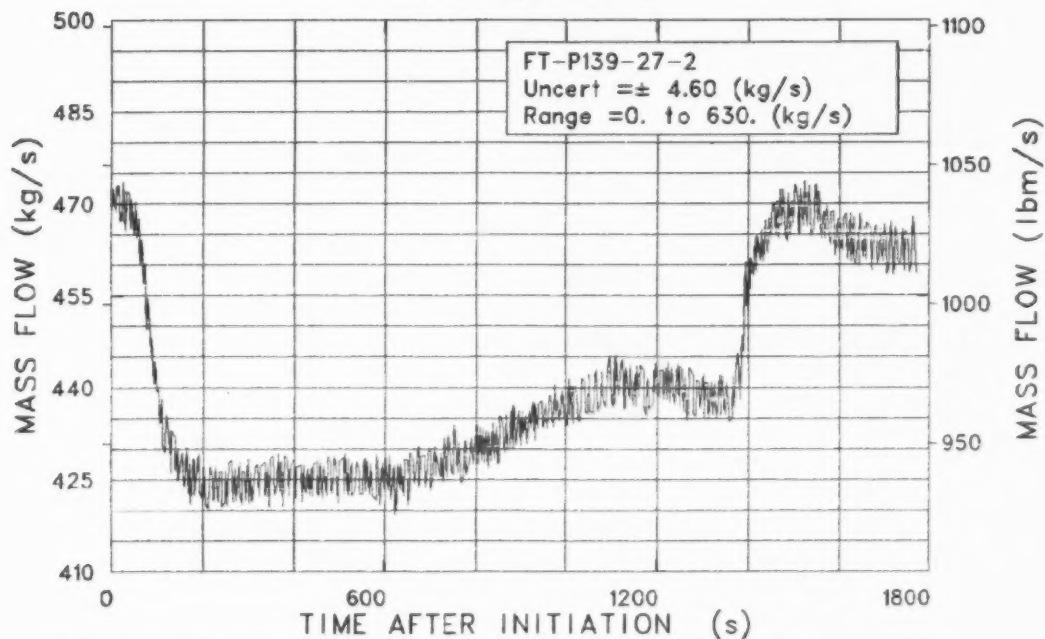


Figure 3L-12. Flow rate in intact loop hot leg venturi
 (FT-P139-27-2).

EXPERIMENT L9-3

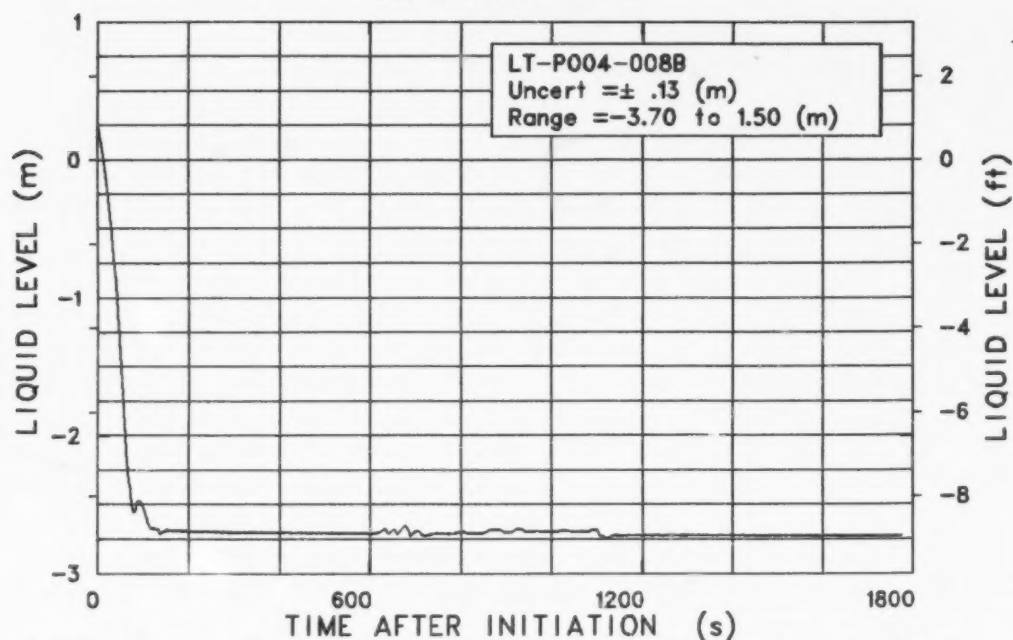


Figure 3L-13. Liquid level in steam generator secondary side, wide range (LT-P004-008B).

EXPERIMENT L9-3

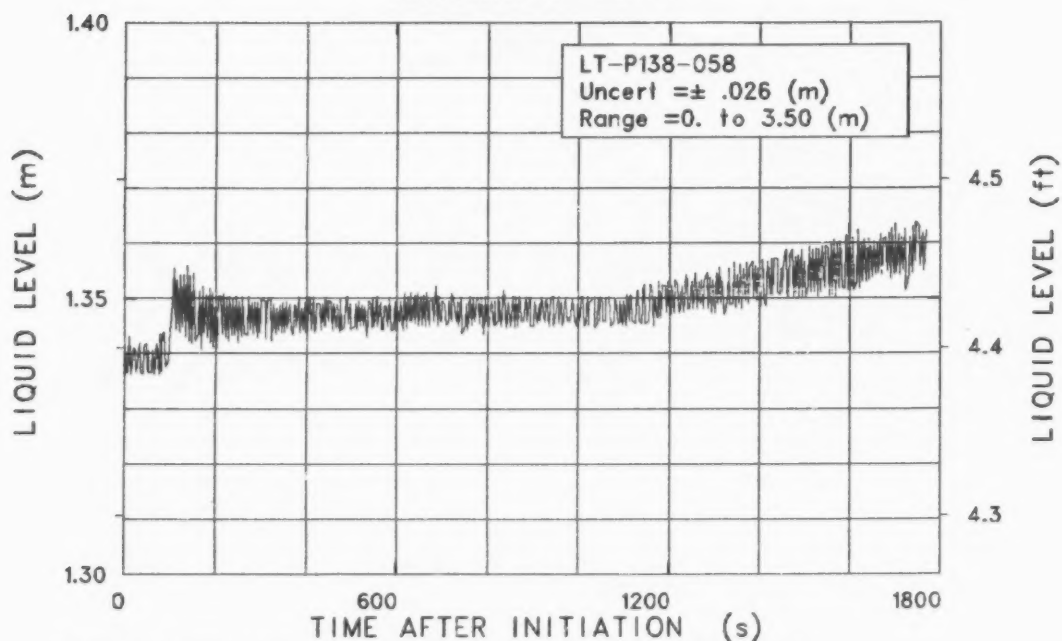


Figure 3L-14. Liquid level in blowdown suppression tank (LT-P138-058).

EXPERIMENT L9-3

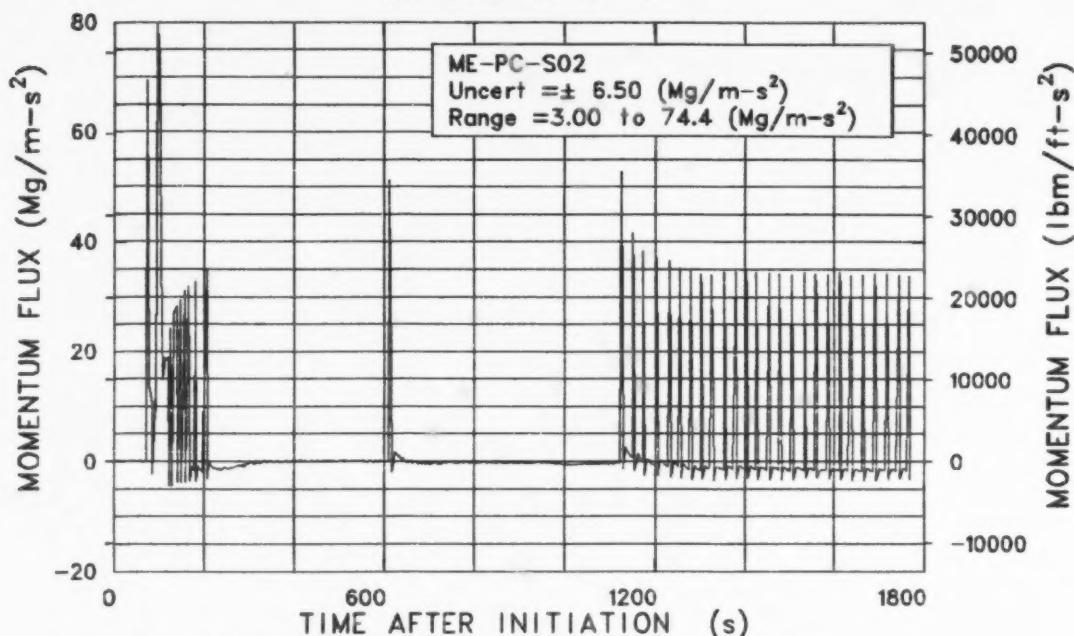


Figure 3L-15. Momentum flux in intact loop pressure relief line upstream of experiment relief valve (ME-PC-S02) (qualified, shows negative momentum due to unresolvable temperature compensation).

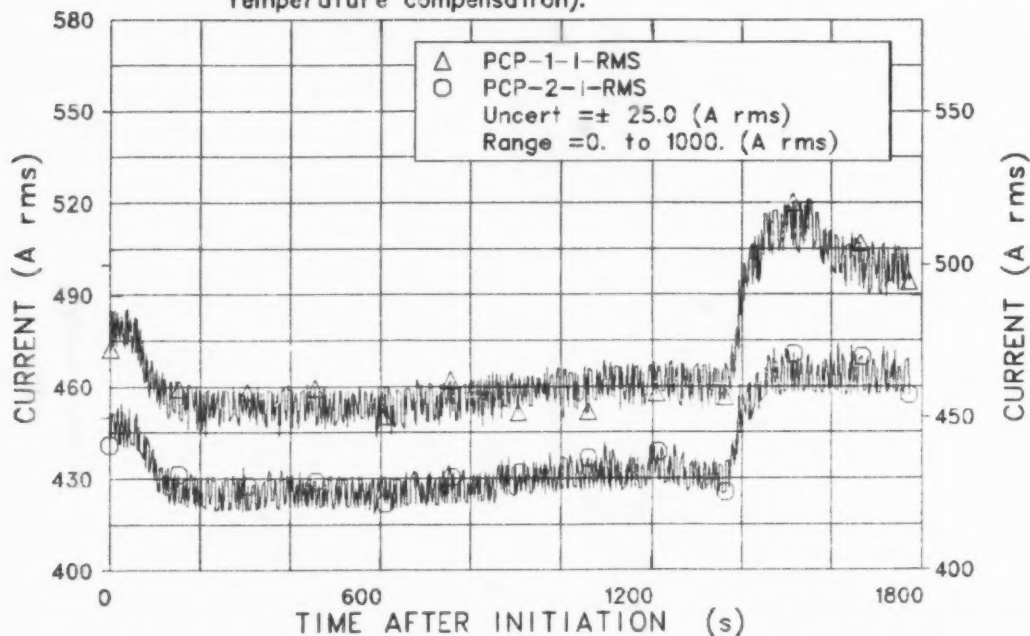


Figure 3L-16. Electrical current for primary coolant Pumps 1 and 2 (PCP-1-I-RMS and -2-I-RMS).

EXPERIMENT L9-3

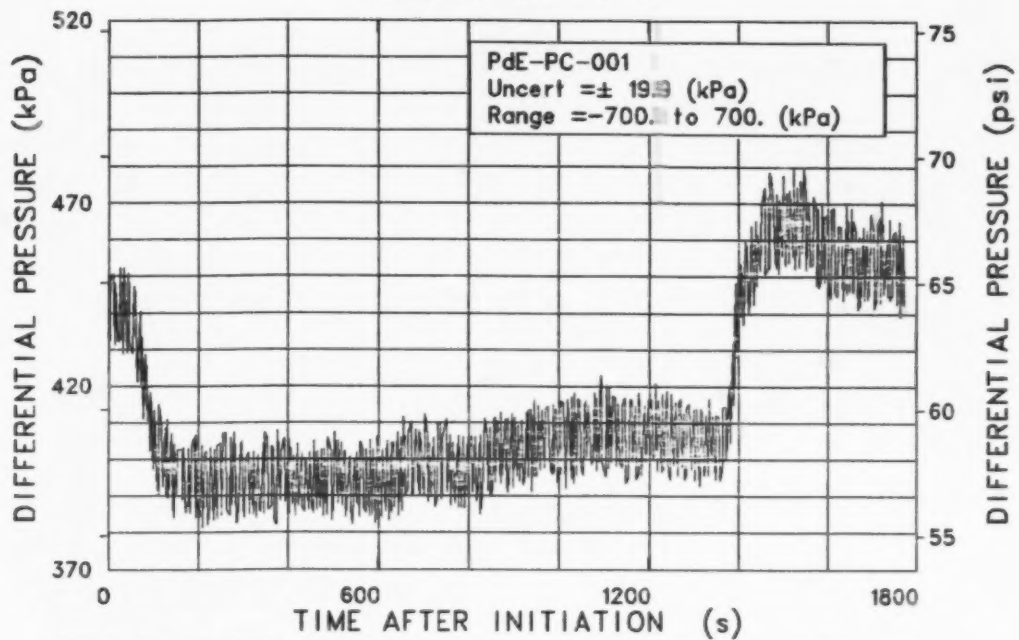


Figure 3L-17. Differential pressure in intact loop across primary coolant Pumps 1 and 2 (PdE-PC-001).

EXPERIMENT L9-3

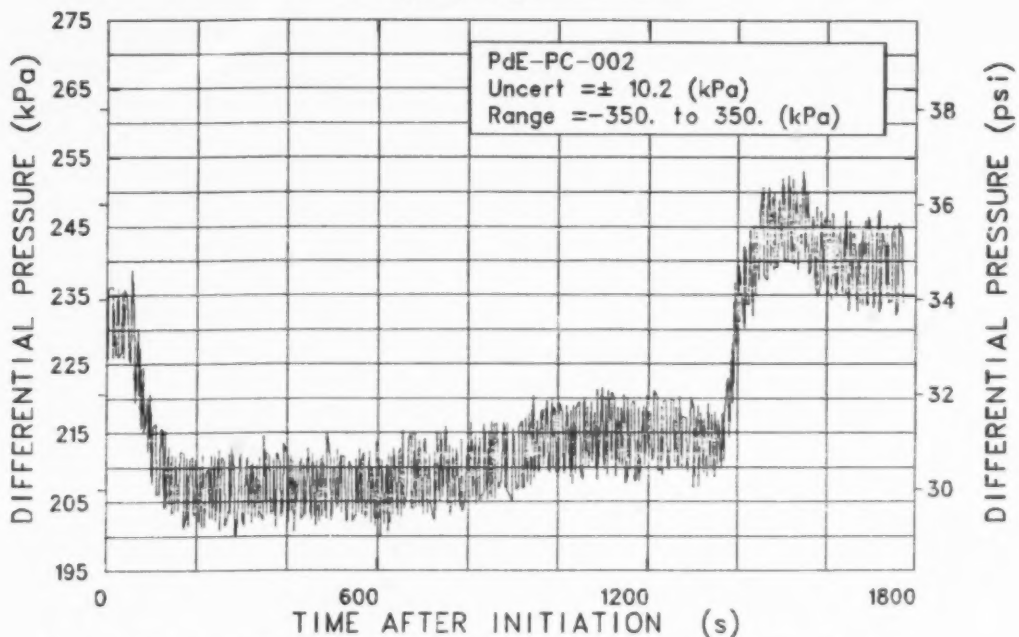


Figure 3L-18. Differential pressure in intact loop across steam generator (PdE-PC-002).

EXPERIMENT L9-3

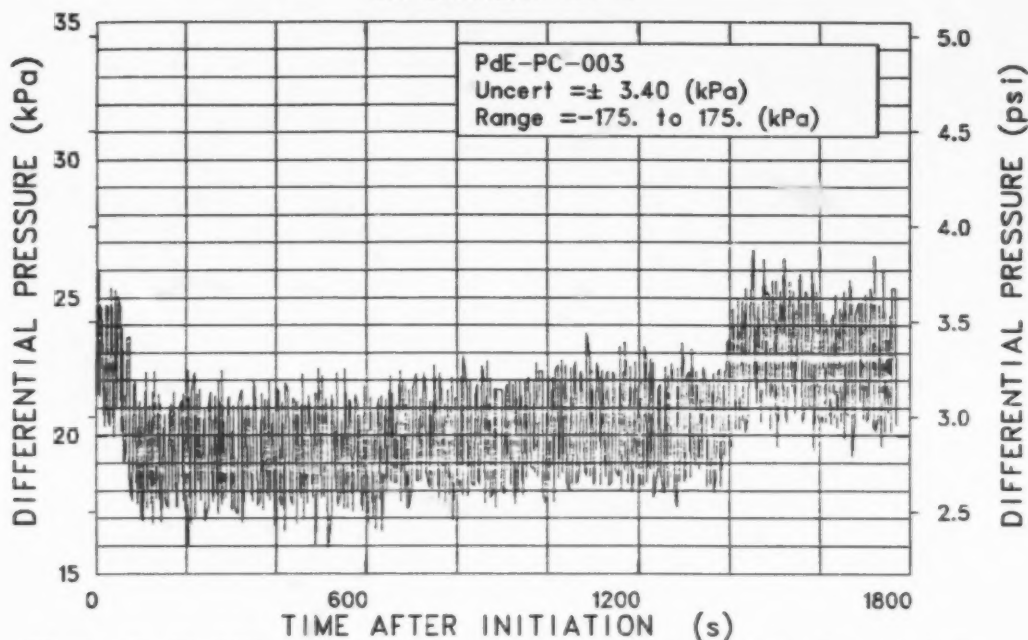


Figure 3L-19. Differential pressure in intact loop hot leg from reactor vessel outlet to steam generator inlet (PdE-PC-003).

EXPERIMENT L9-3

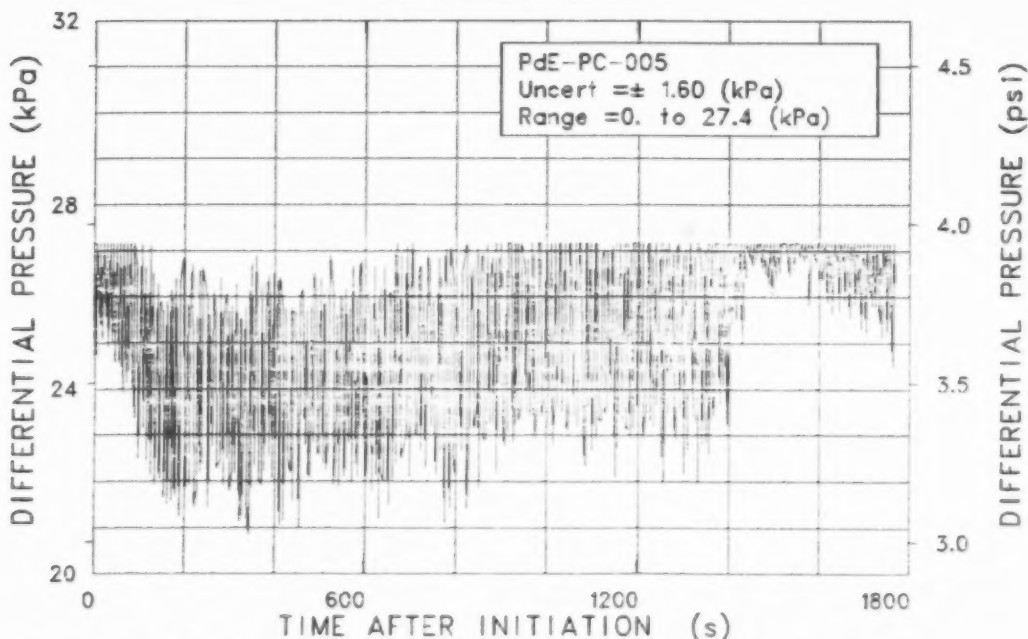


Figure 3L-20. Differential pressure in intact loop cold leg from primary coolant pump discharge to reactor vessel inlet (PdE-PC-005) (qualified, clipped at 27.4 kPa).

EXPERIMENT L9-3

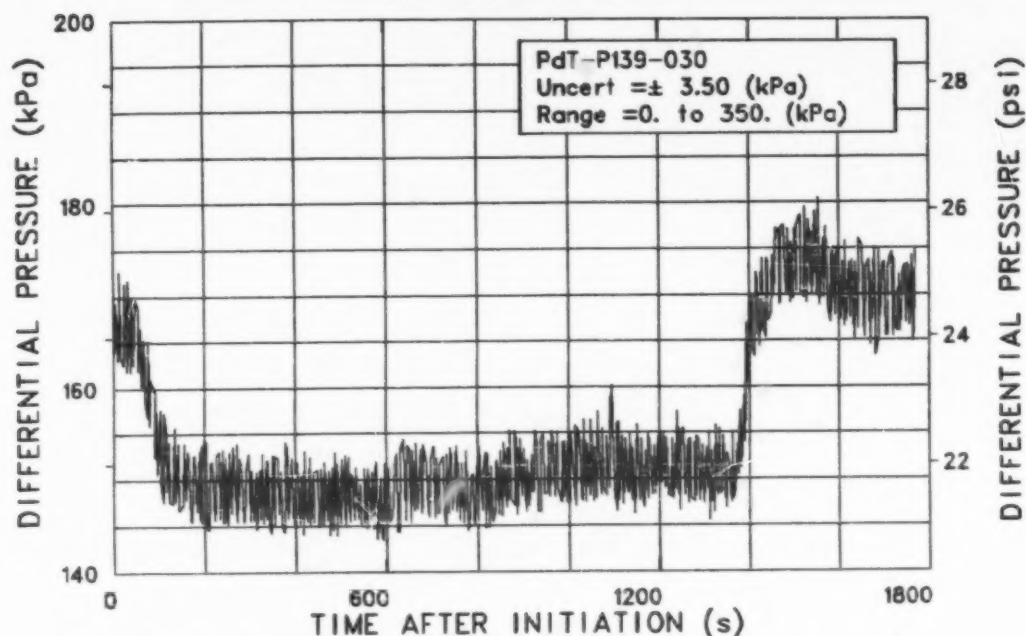


Figure 3L-21. Differential pressure in intact loop across reactor vessel (PdT-P139-030).

EXPERIMENT L9-3

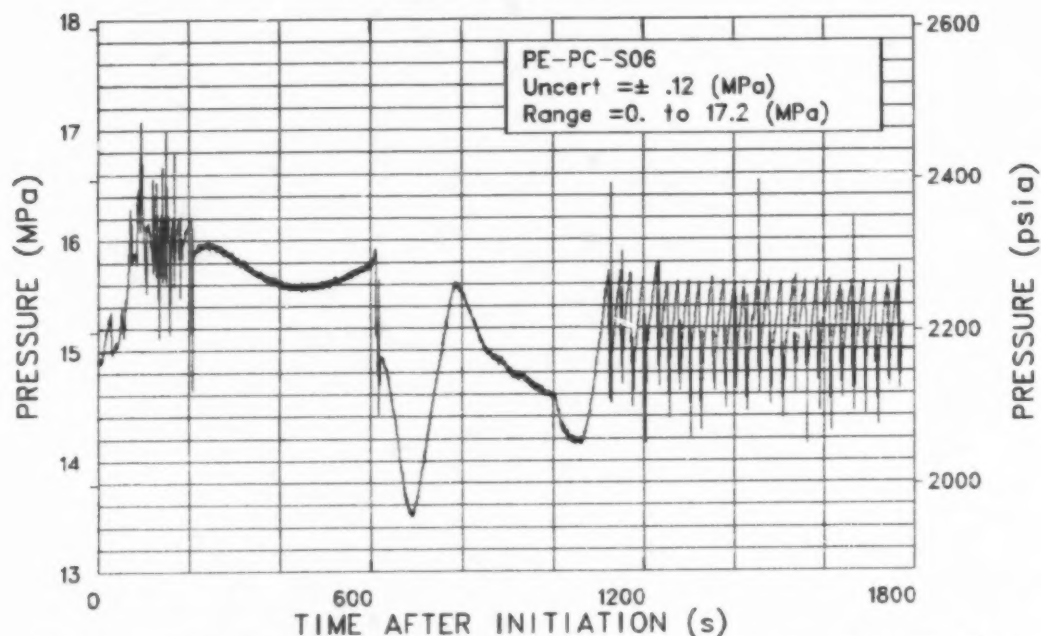


Figure 3L-22. Pressure in intact loop pressure relief line upstream of experiment relief valve (PE-PC-S06).

EXPERIMENT L9-3

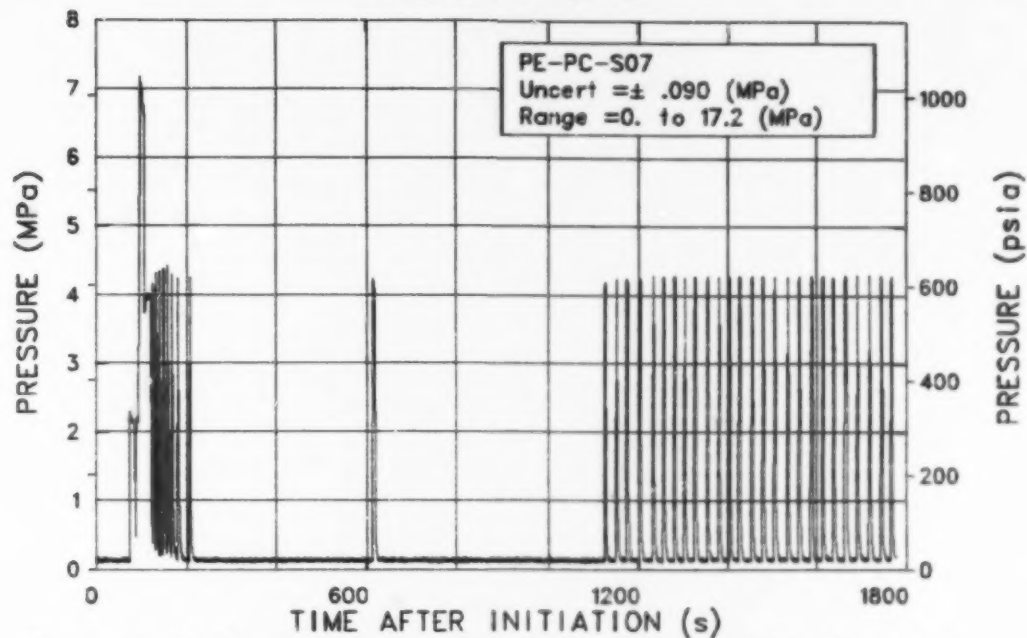


Figure 3L-23. Pressure in intact loop pressure relief line downstream of experiment relief valve (PE-PC-S07).

EXPERIMENT L9-3

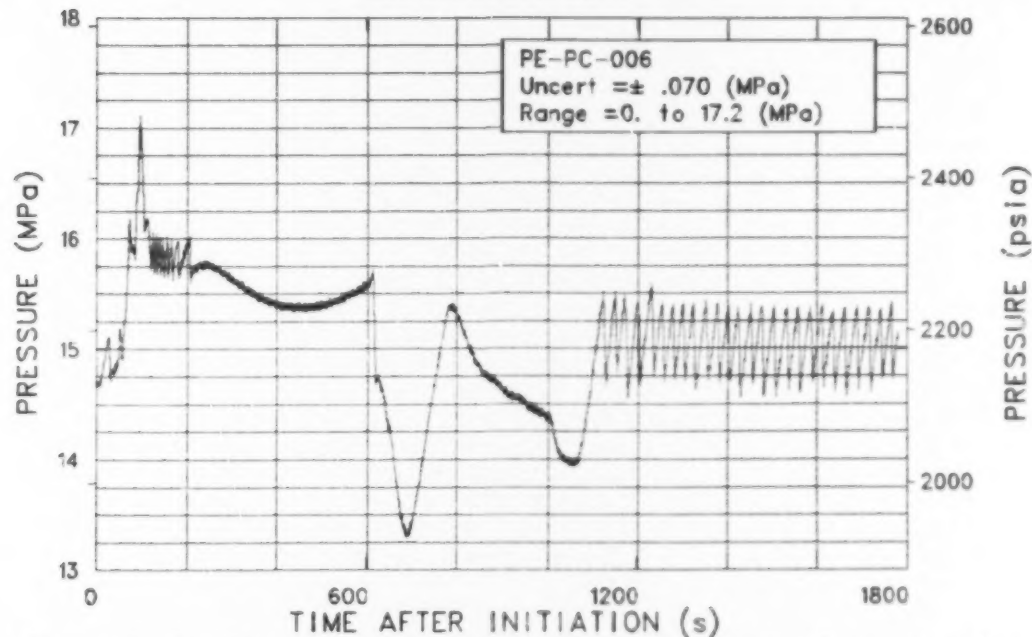


Figure 3L-24. Reference pressure in intact loop between steam generator outlet and primary coolant pump inlet (PE-PC-006).

EXPERIMENT L9-3

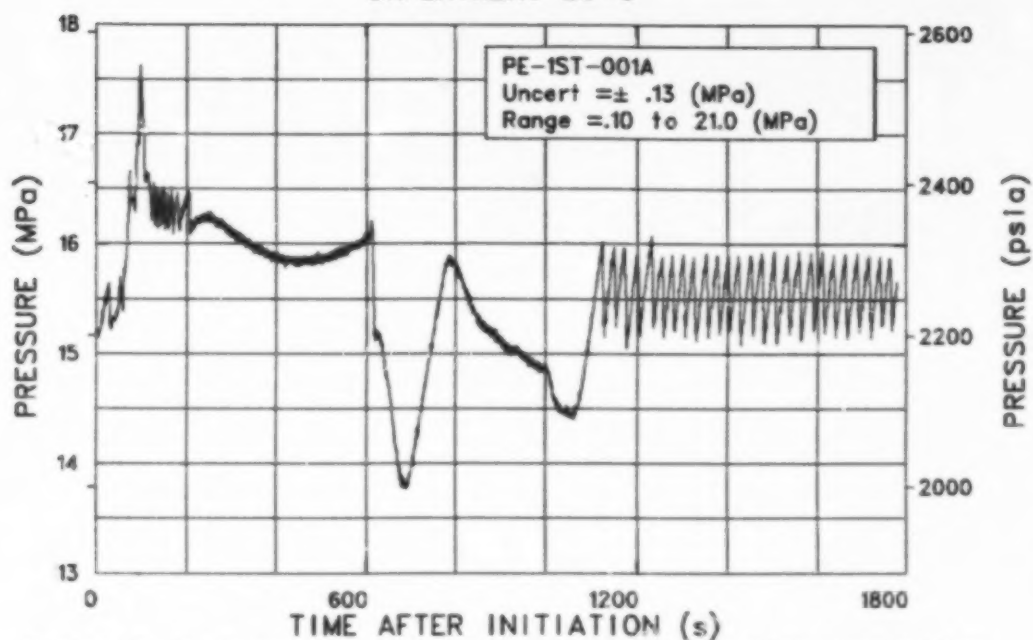


Figure 3L-25. Pressure in reactor vessel Downcomer Stalk 1 at 0.62 m above reactor vessel bottom, wide range (PE-1ST-001A).

EXPERIMENT L9-3

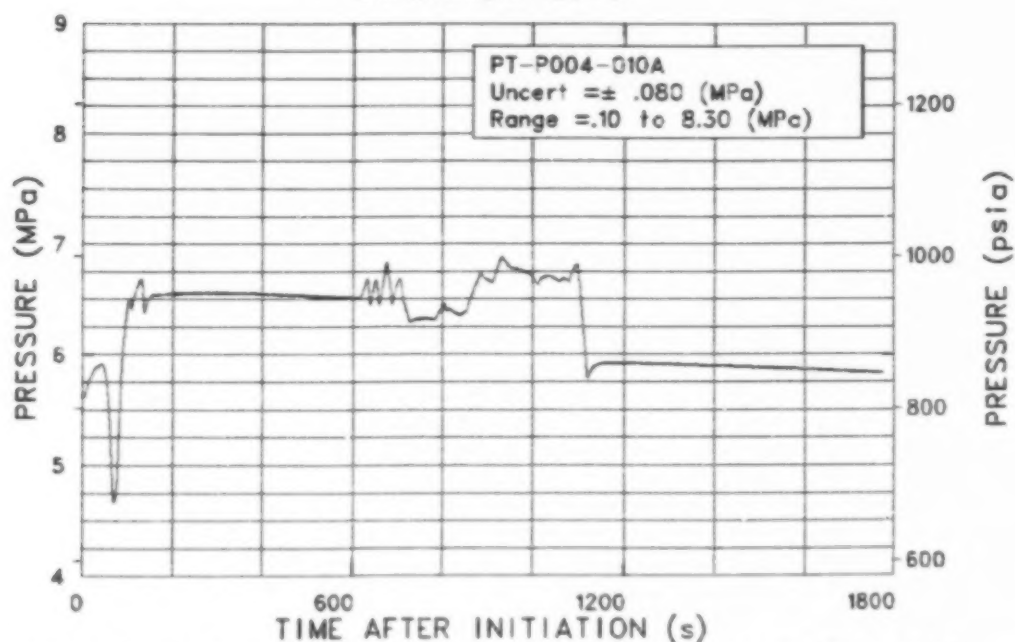


Figure 3L-26. Pressure in steam generator secondary side 10-in outlet (PT-P004-010A).

EXPERIMENT L9-3

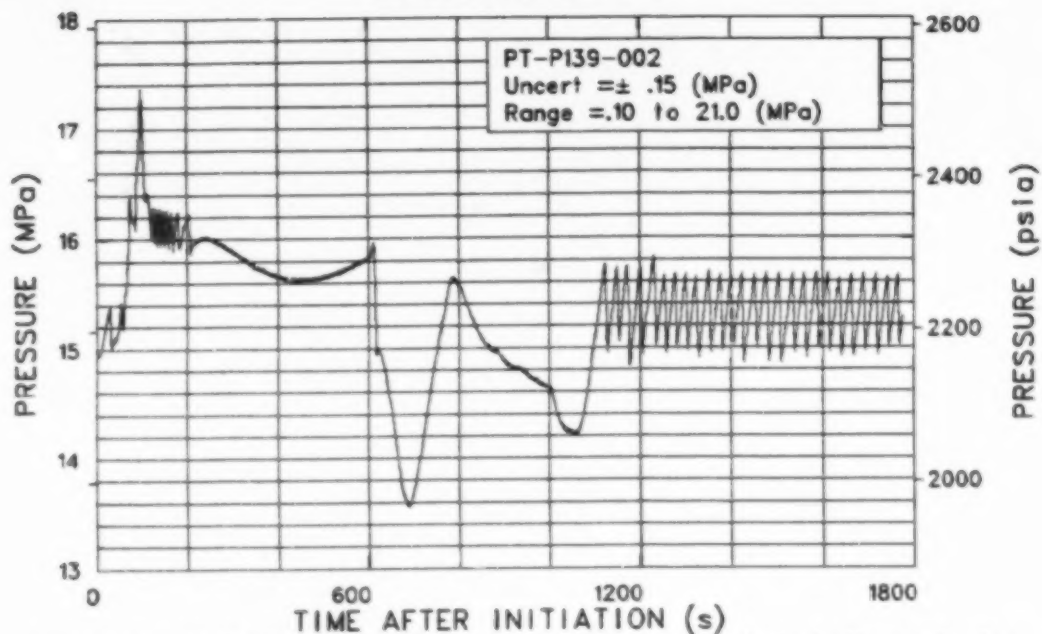


Figure 3L-27. Pressure in intact loop hot leg venturi on bottom of pipe (PT-P139-002).

EXPERIMENT L9-3

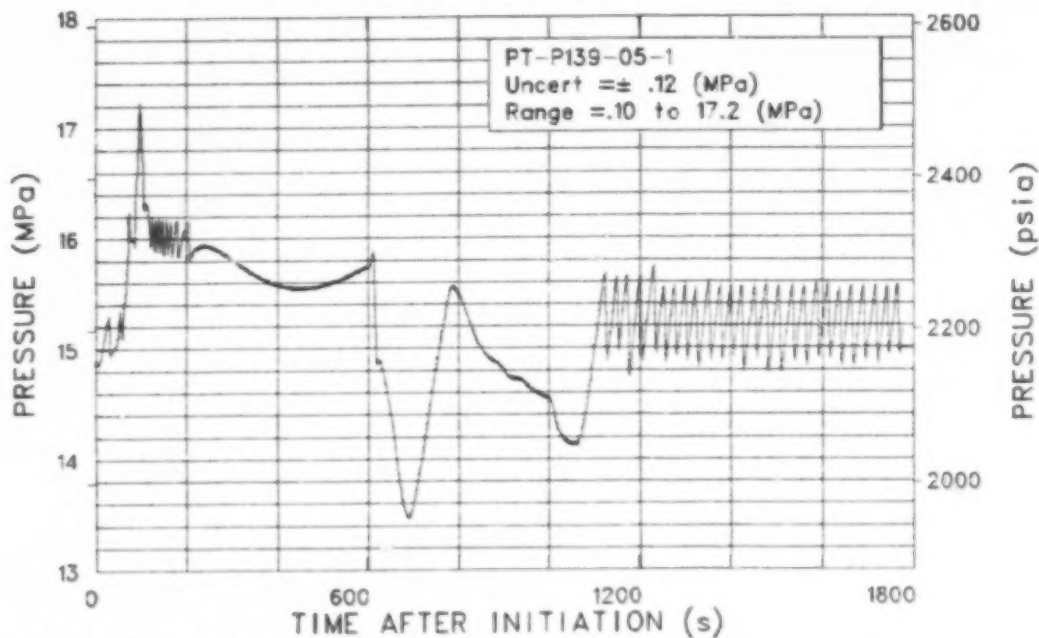


Figure 3L-28. Pressure in intact loop pressurizer vapor space (PT-P139-05-1).

EXPERIMENT L9-3

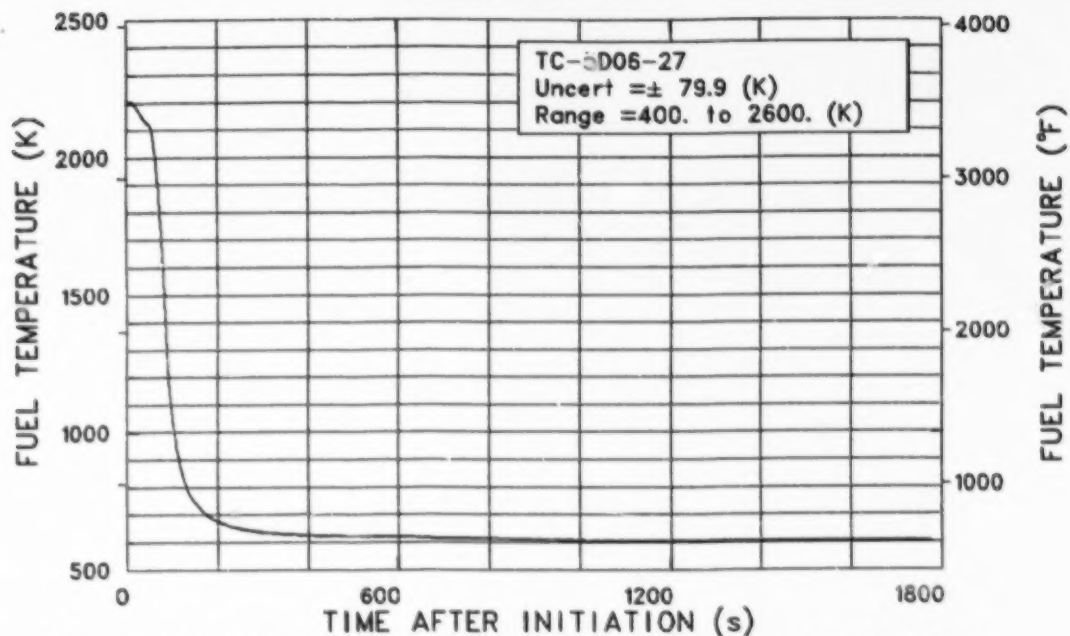


Figure 3L-29. Fuel centerline temperature in reactor vessel at Fuel Assembly 5, Row D, Column 6 at 0.69 m above bottom of fuel rod (TC-5D06-27).

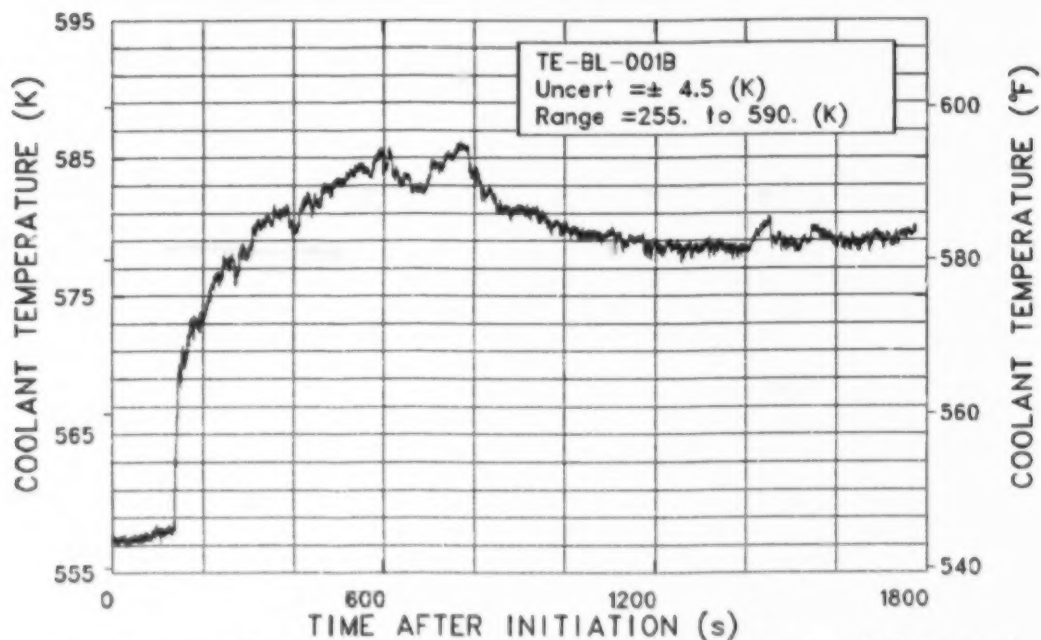


Figure 3L-30. Coolant temperature in broken loop cold leg (TE-BL-001B) (qualified, no other measurement for direct comparison).

EXPERIMENT L9-3

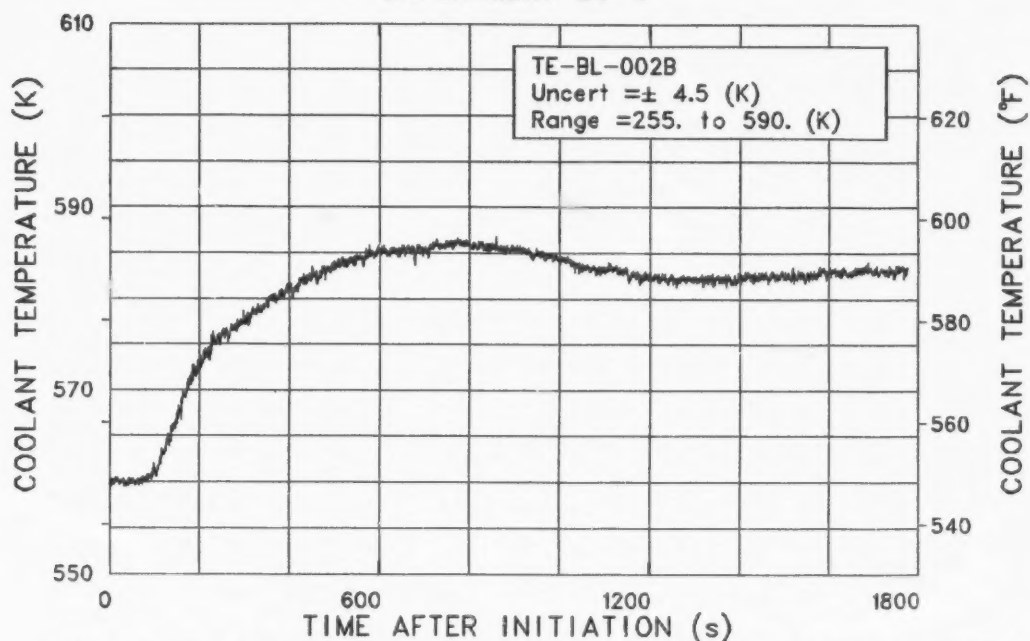


Figure 3L-31. Coolant temperature in broken loop hot leg (TE-BL-002B) (qualified, no other measurement for direct comparison).

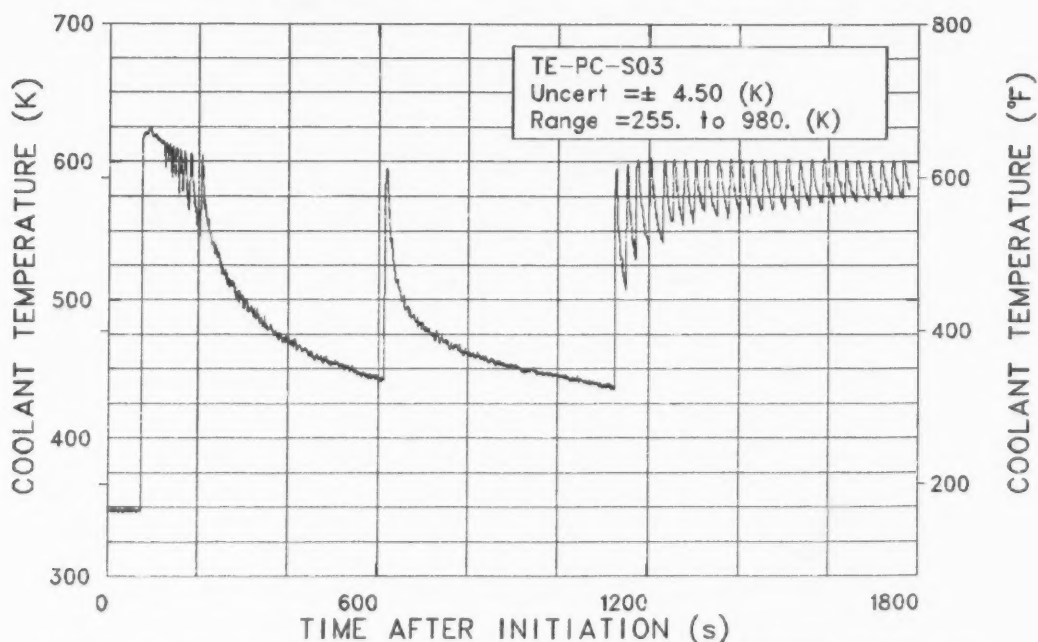


Figure 3L-32. Coolant temperature in intact loop pressure relief line upstream of experiment relief valve (TE-PC-S03).

EXPERIMENT L9-3

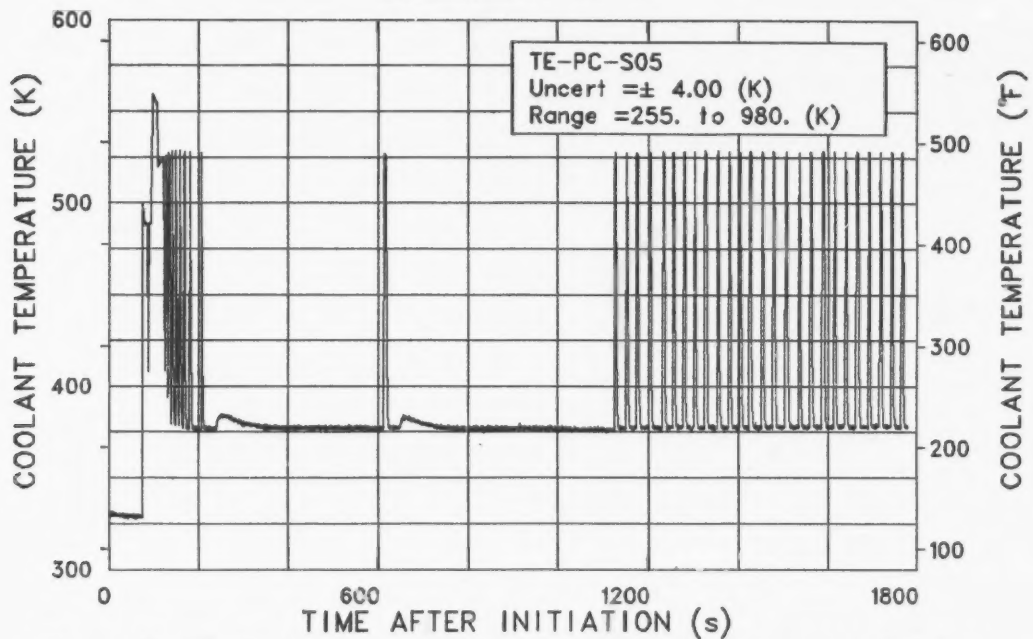


Figure 3L-33. Coolant temperature in intact loop pressure relief line downstream of experiment relief valve (TE-PC-S05).

EXPERIMENT L9-3

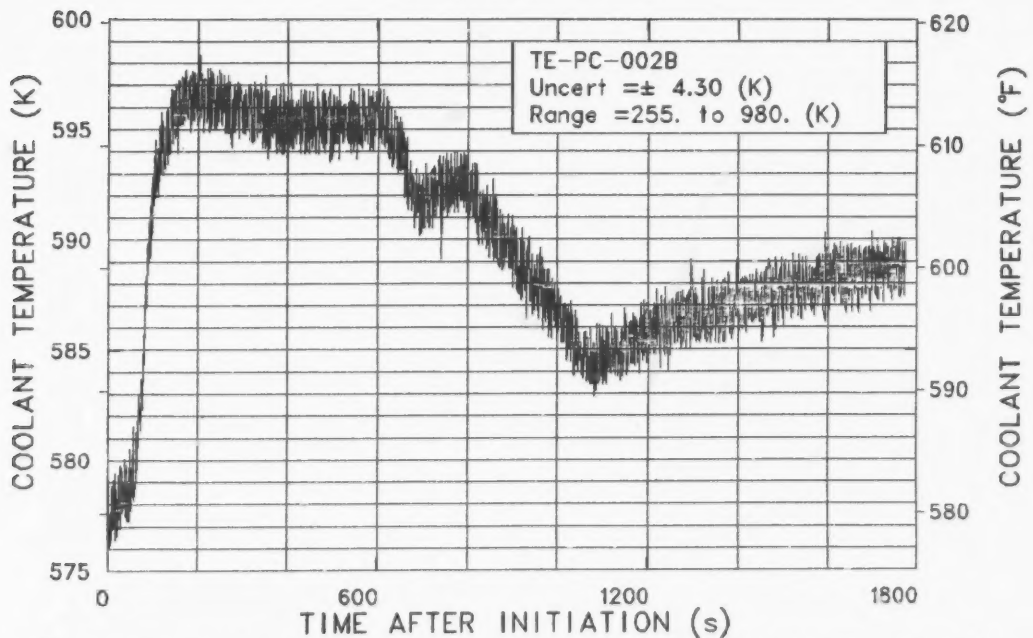


Figure 3L-34. Coolant temperature in intact loop hot leg DTT rake at middle of pipe (TE-PC-002B).

EXPERIMENT L9-3

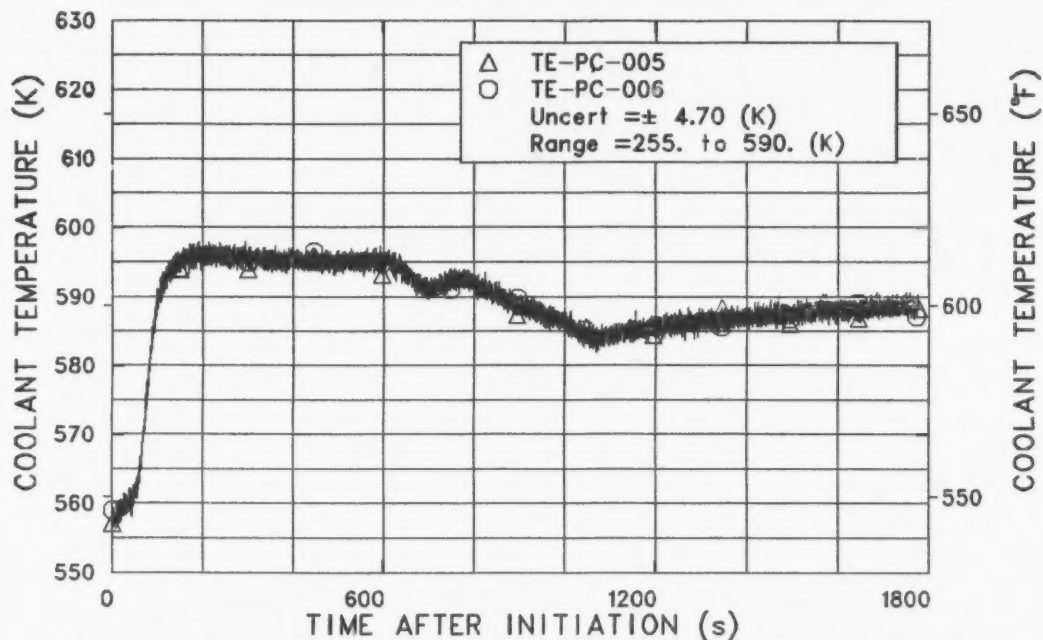


Figure 3L-35. Coolant temperature in intact loop next to bottom and next to top of ECC Rake 1 (TE-PC-005 and -006).

EXPERIMENT L9-3

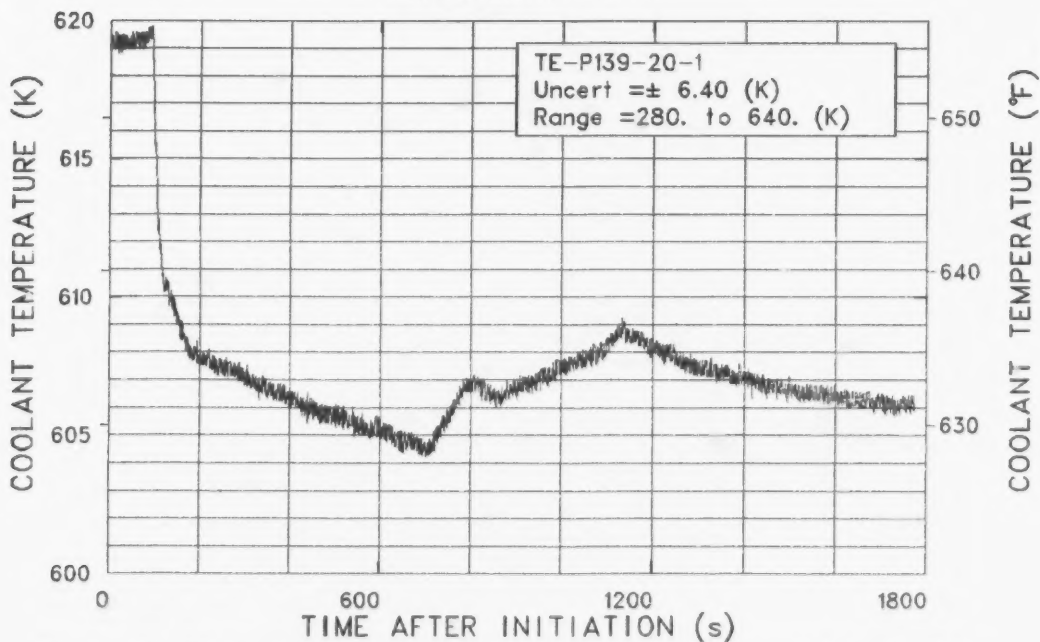


Figure 3L-36. Coolant temperature in intact loop pressurizer liquid volume (TE-P139-20-1).

EXPERIMENT L9-3

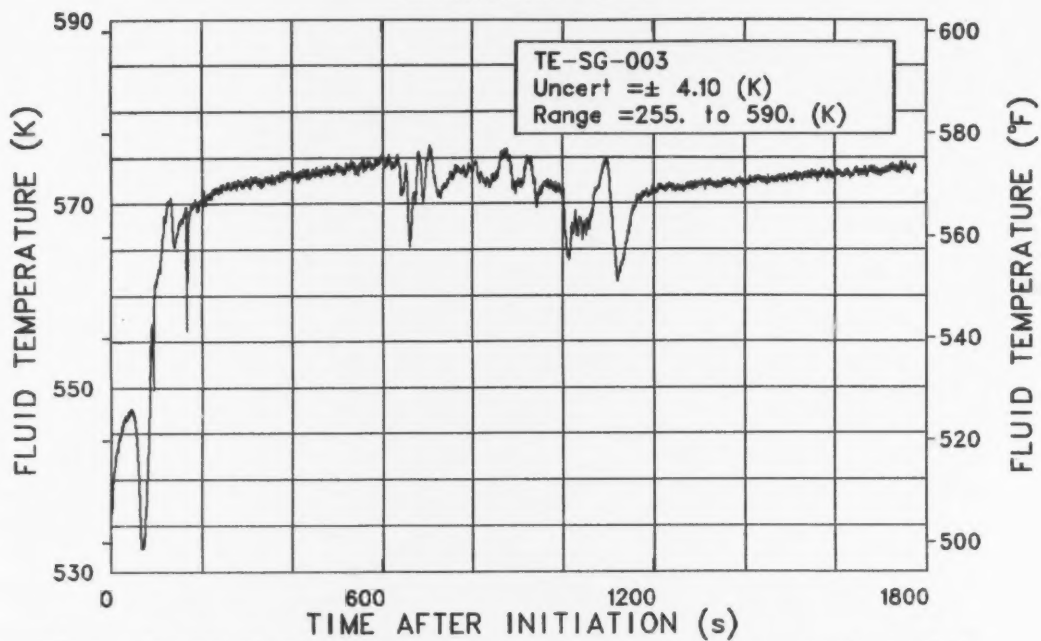


Figure 3L-37. Fluid temperature in steam generator secondary side downcomer at 0.25 m above top of tube sheet (TE-SG-003).

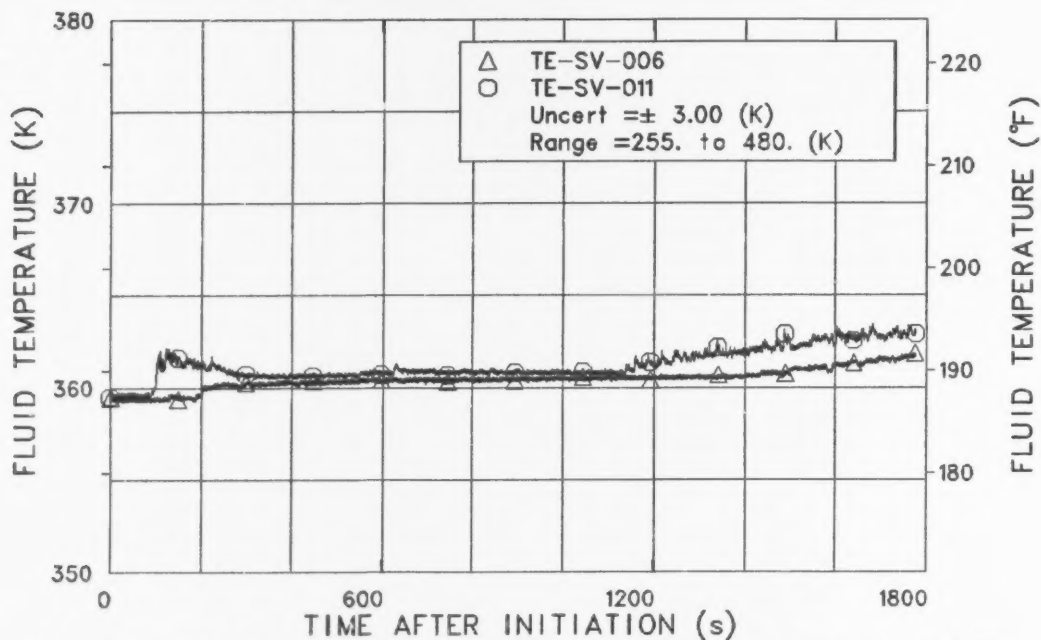


Figure 3L-38. Fluid temperature in blowdown suppression tank at 0.37 and 0.99 m above tank bottom (TE-SV-006 and -011).

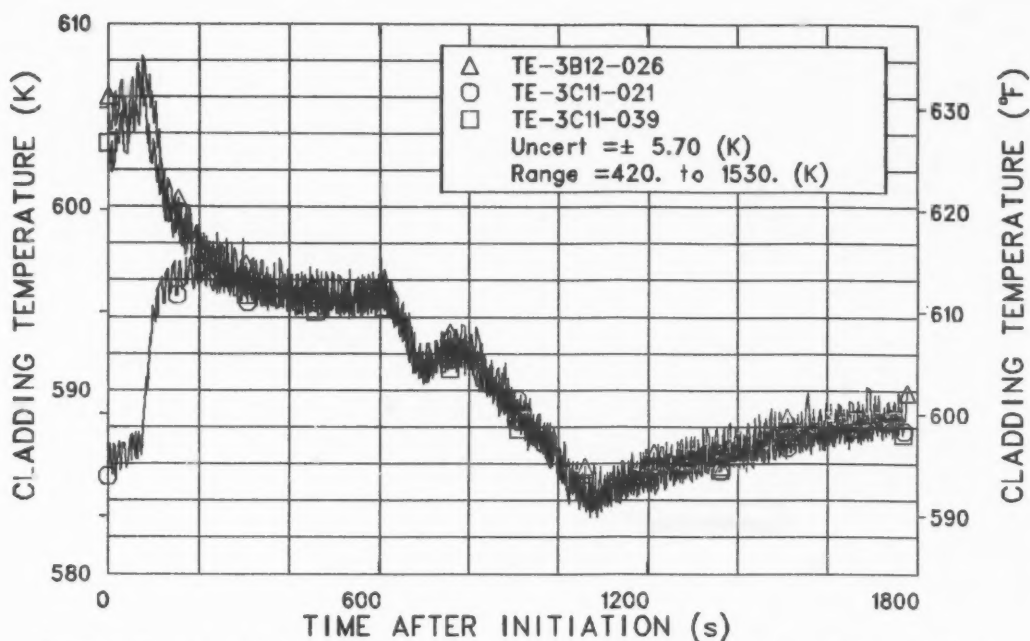


Figure 3L-39. Cladding temperature at Fuel Assembly 3, Rows B and C, Columns 11 and 12 at 0.66, 0.53, and 0.99 m above bottom of fuel rod (TE-3B12-026, -3C11-021, and -039).

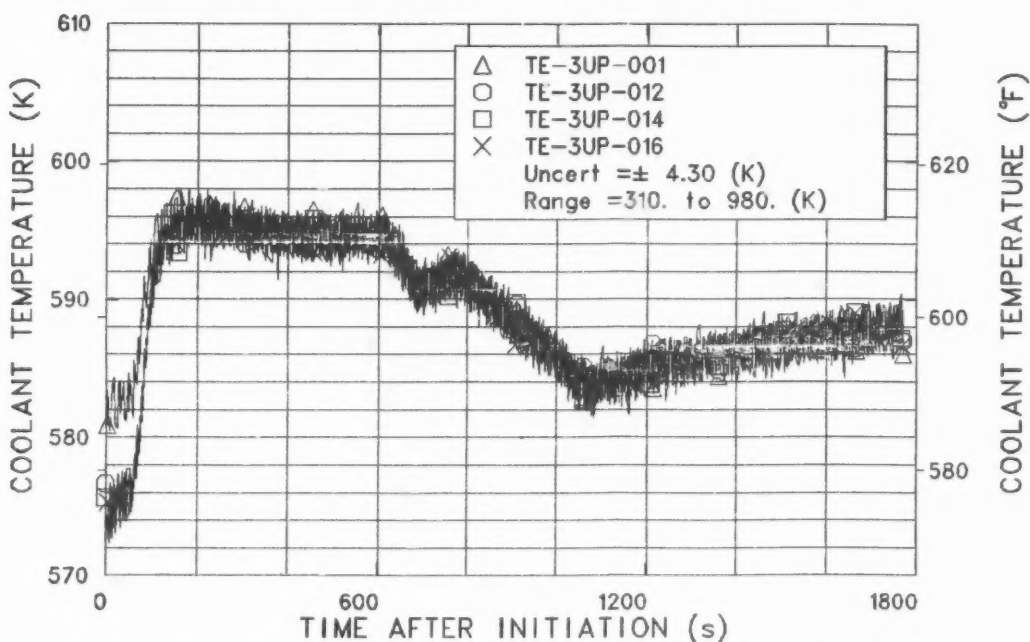


Figure 3L-40. Coolant temperature in upper plenum above Fuel Assembly 3 (TE-3UP-001, -012, -014, and -016).

EXPERIMENT L9-3

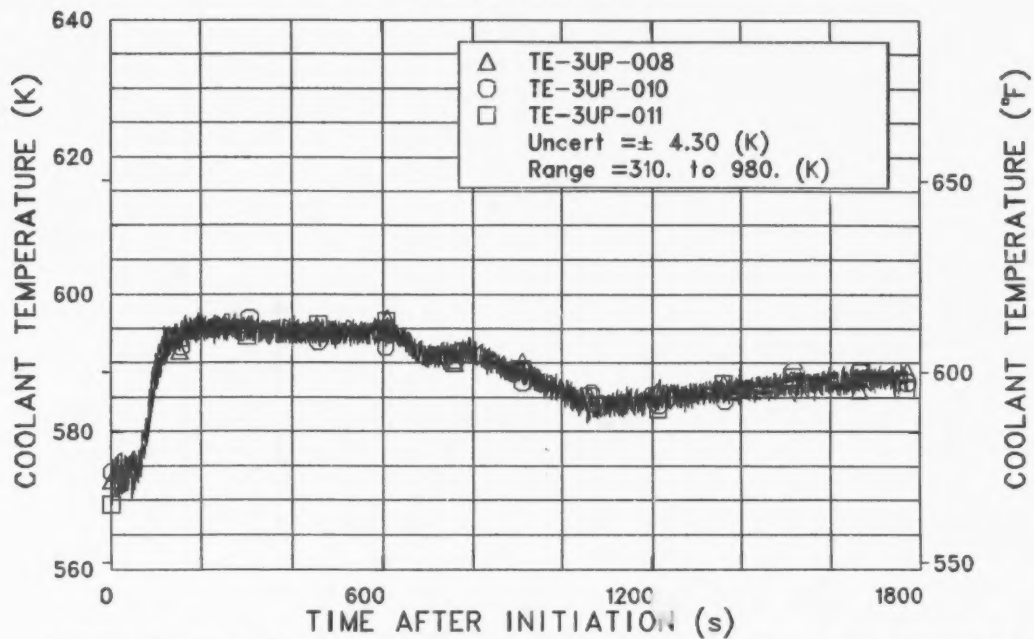


Figure 3L-41. Coolant temperature in upper plenum above Fuel Assembly 3 (TE-3UP-008, -010, and -011).

EXPERIMENT L9-3

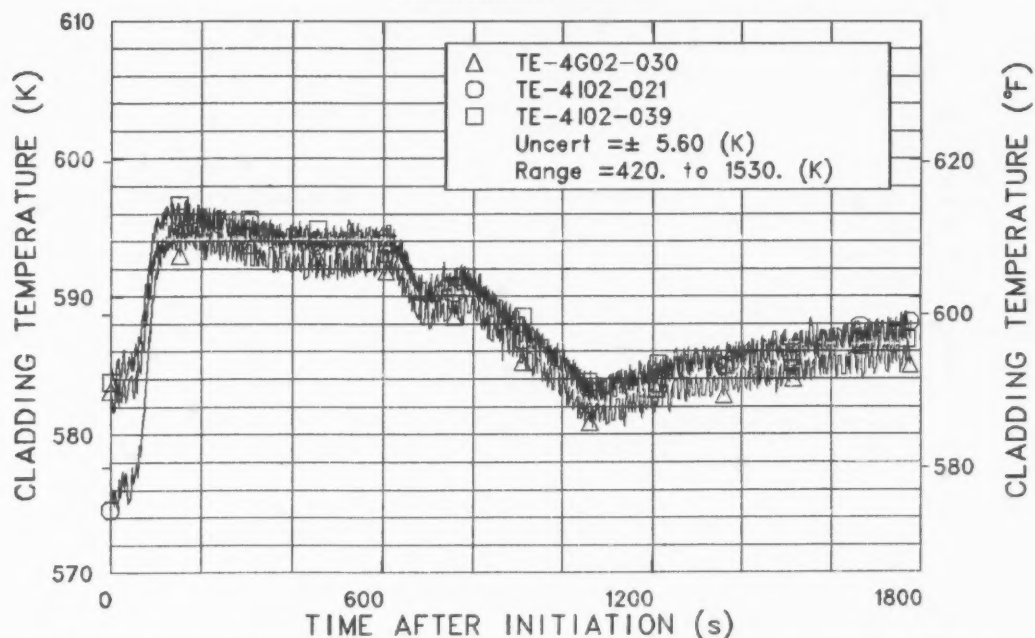


Figure 3L-42. Cladding temperature at Fuel Assembly 4, Rows G and I, Column 2 at 0.76, 0.53 and 0.99 m above bottom of fuel rod (TE-4G02-030, -4I02-021, and -039).

EXPERIMENT L9-3

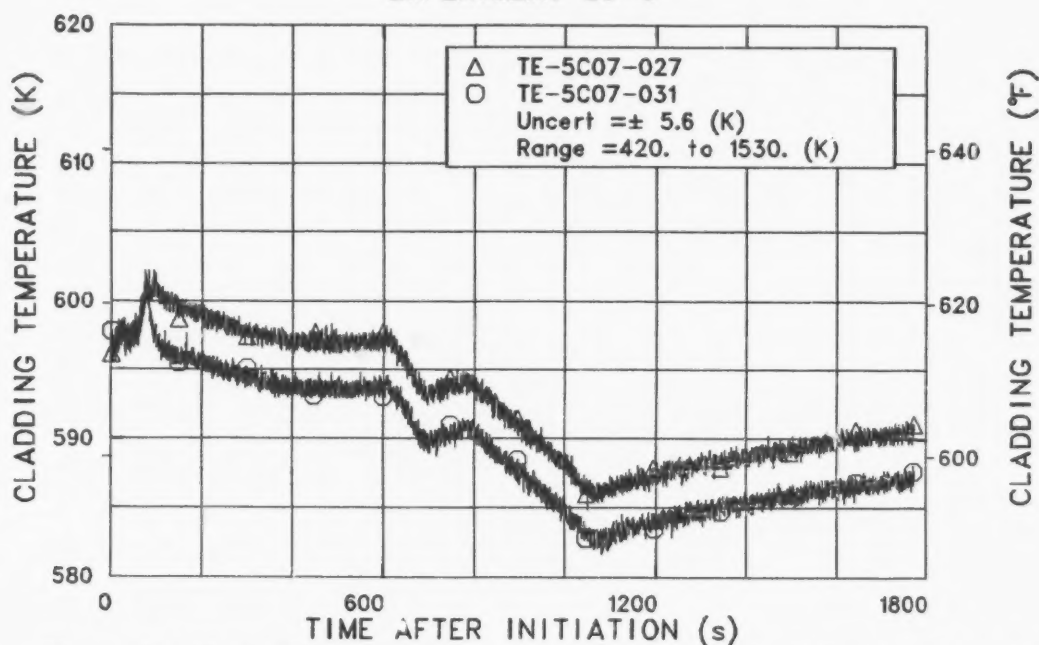


Figure 3L-43. Cladding temperature at Fuel Assembly 5, Row C, Column 7 at 0.69 and 0.79 m above bottom of fuel rod (TE-5C07-027 and -031).

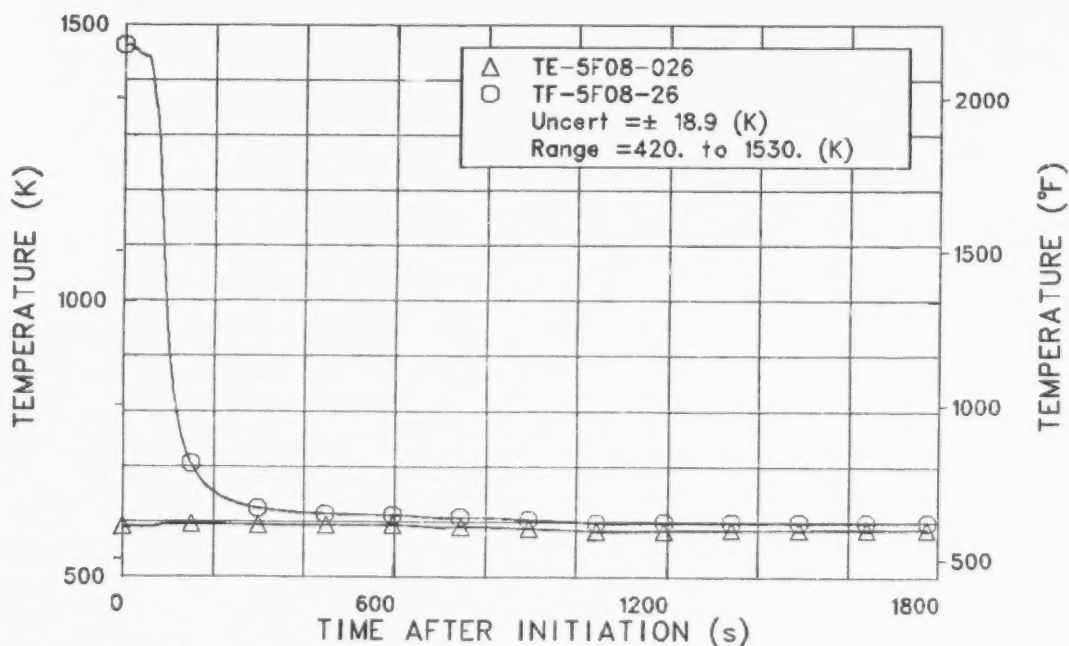


Figure 3L-44. Cladding and pellet surface temperature at Fuel Assembly 5, Row F, Column 8 at 0.66 m above bottom of fuel rod (TE-5F08-026 and TF-5F08-26).

EXPERIMENT L9-3

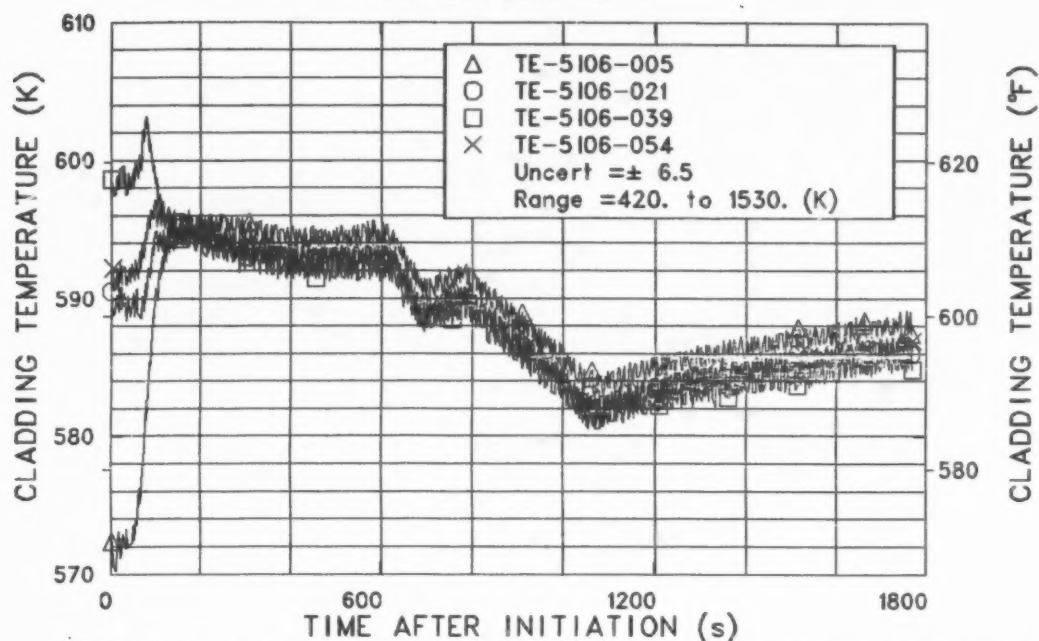


Figure 3L-45. Cladding temperature at Fuel Assembly 5, Row I, Column 6 at 0.13, 0.53, 0.99, and 1.37 m above bottom of fuel rod (TE-5106-005, -021, -039, and -054).

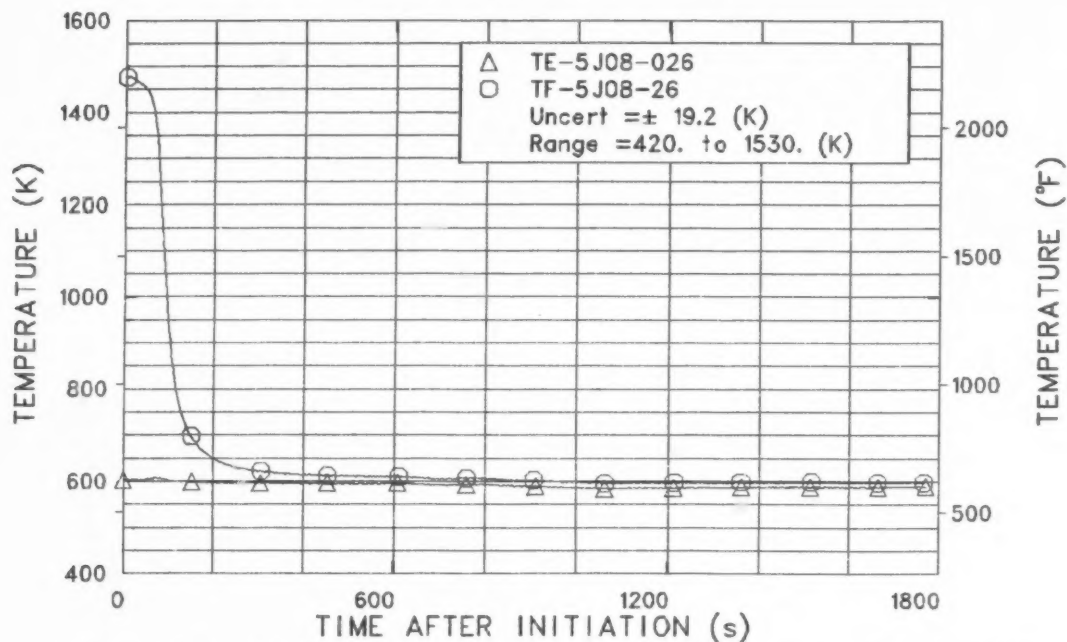


Figure 3L-46. Cladding and pellet surface temperature at Fuel Assembly 5, Row J, Column 8 at 0.66 m above bottom of fuel rod (TE-5J08-026 and TF-5J08-26).

EXPERIMENT L9-3

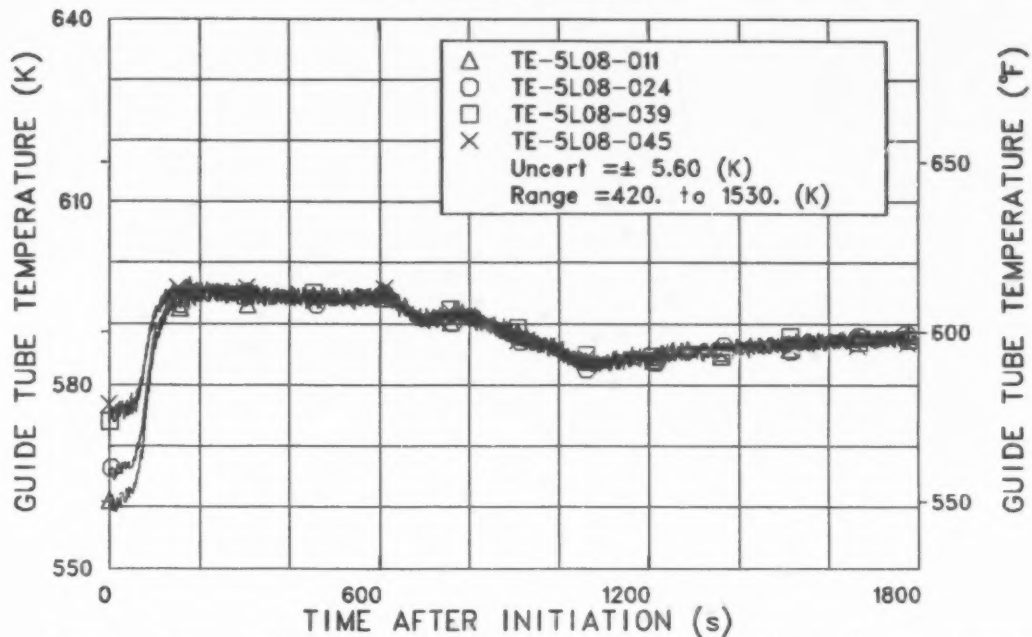


Figure 3L-47. Guide tube temperature at Fuel Assembly 5, Row L, Column 8 at 0.28, 0.61, 0.99, and 1.14 m above bottom of guide tube (TE-5L08-011, -024, -039, and -045).

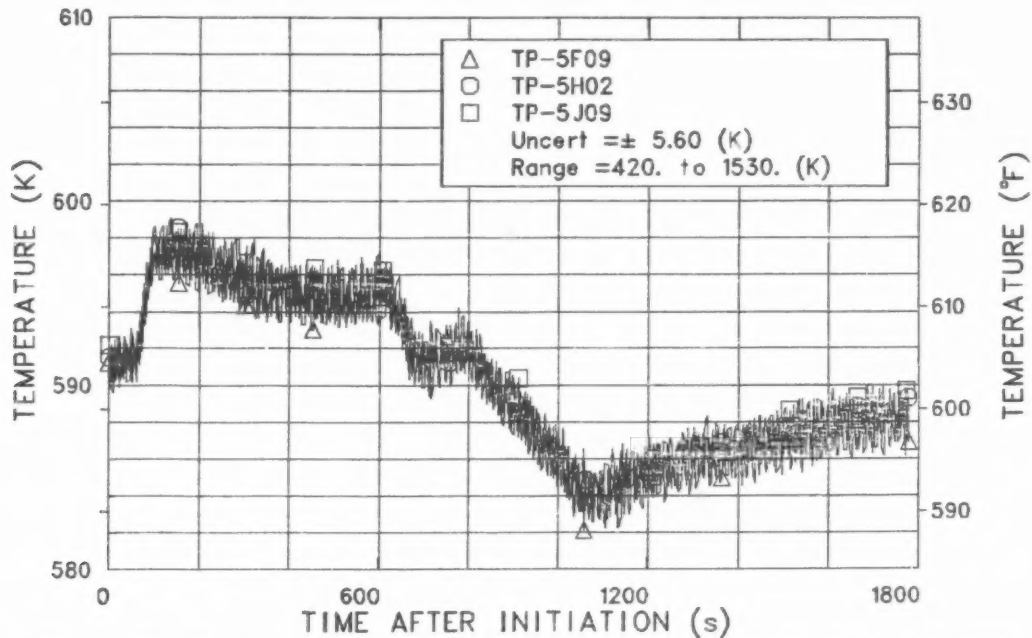


Figure 3L-48. Fuel rod plenum temperature at Rows F, H, and J, Columns 9 and 2 of Fuel Assembly 5 (TP-5F09, -5H02, and -5J09).

EXPERIMENT L9-3

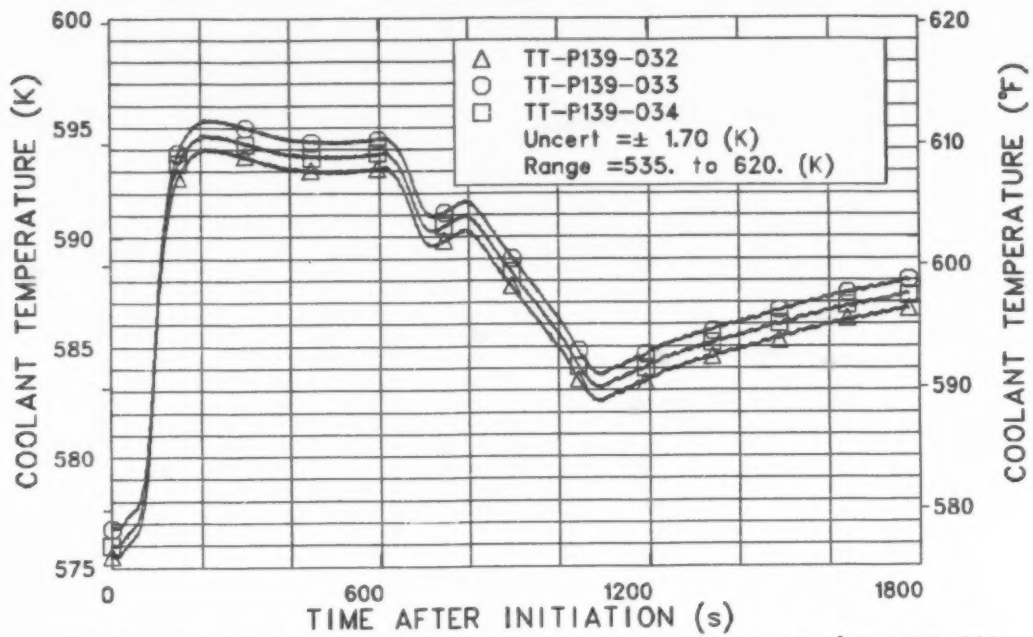


Figure 3L-49. Coolant temperature in intact loop hot leg (TT-P139-032, -033, and -034).

Computed Variables

EXPERIMENT L9-3

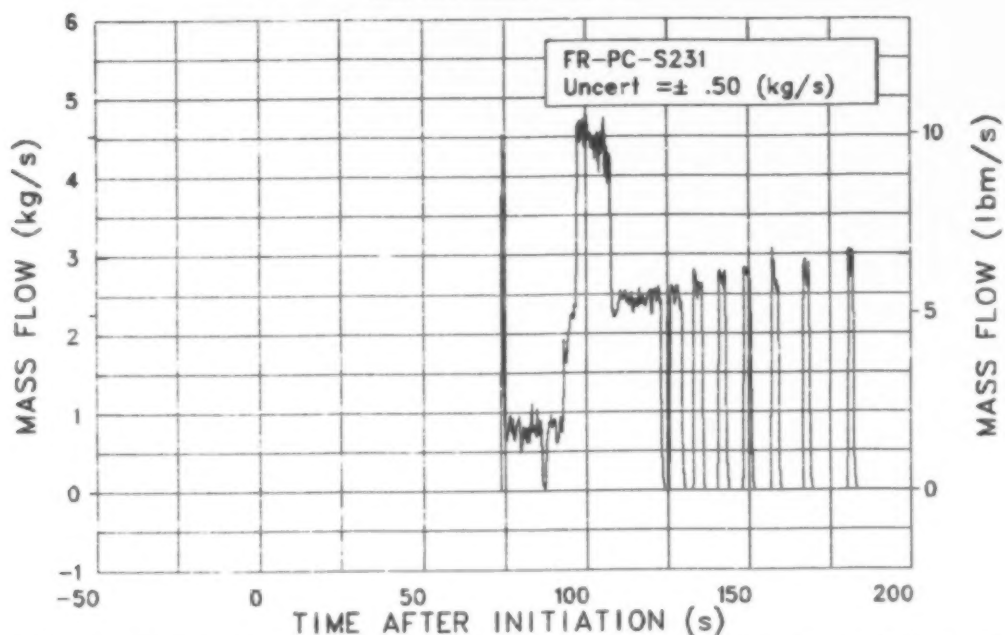


Figure 3C-1. Mass flow rate in the pressure relief line calculated from FE-PC-S02 and DE-PC-S03 (FR-PC-S231).

EXPERIMENT L9-3

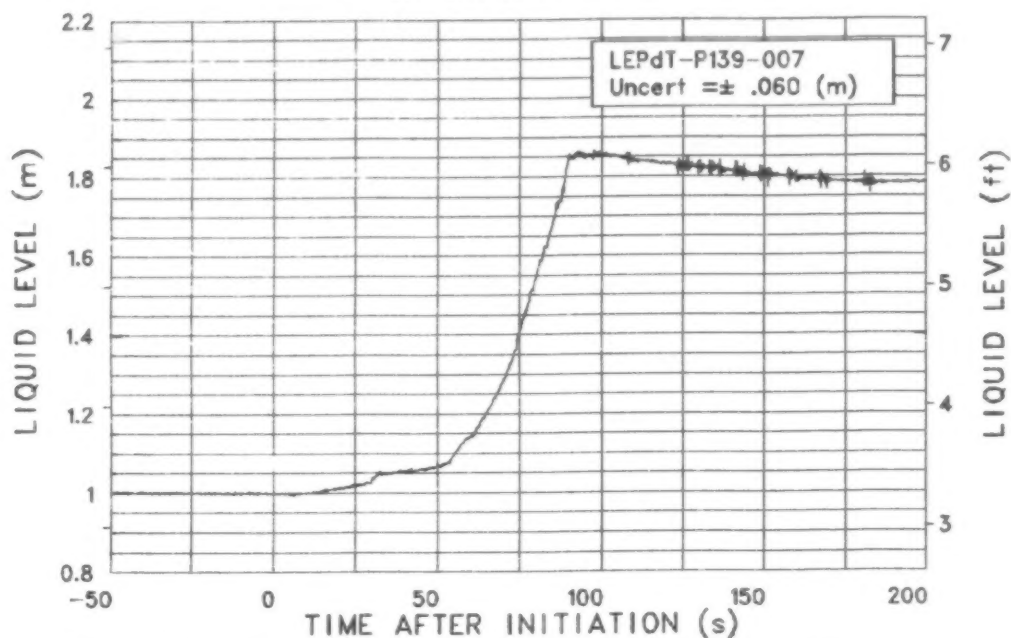


Figure 3C-2. Density compensated liquid level in pressurizer (LEPdT-P139-007) (uncertainty is 0.1 m from 0 to 150 s).

EXPERIMENT L9-3

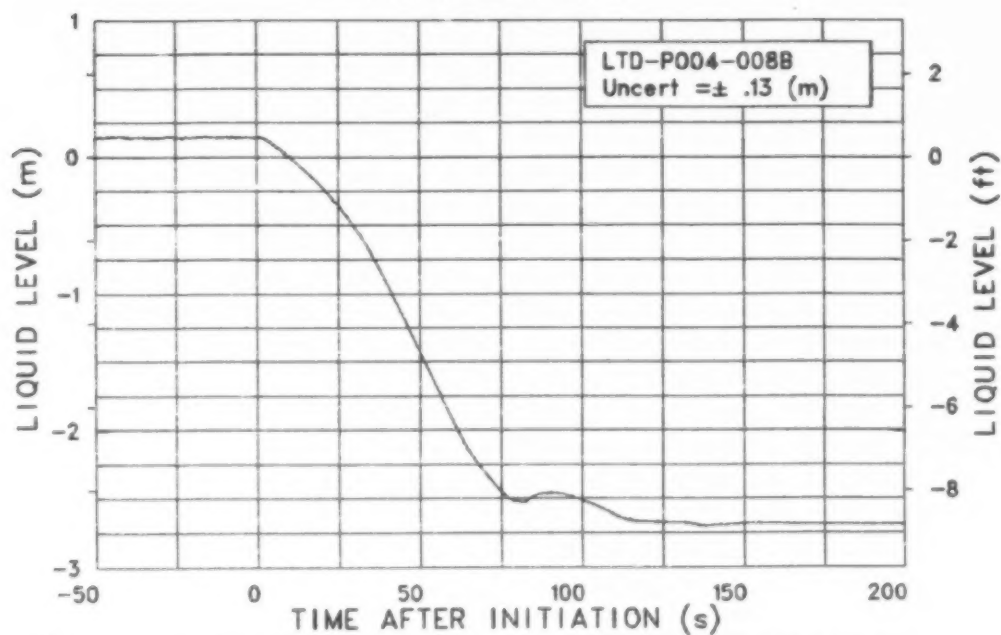


Figure 3C-3. Density compensated liquid level in steam generator (LTD-P004-008B).

EXPERIMENT L9-3

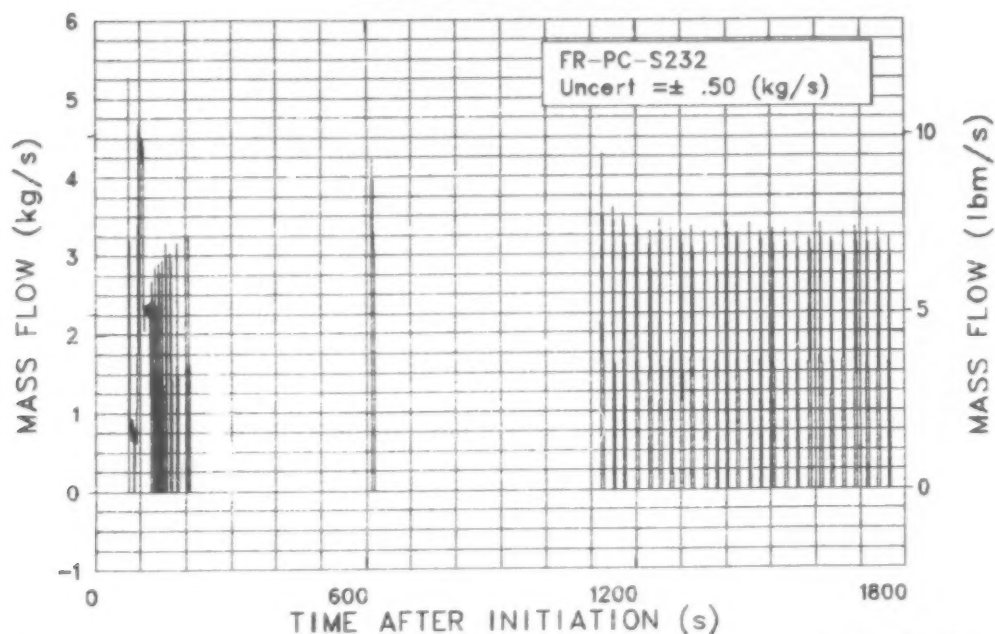


Figure 3C-4. Mass flow rate in the pressure relief line calculated from DE-PC-S03 and ME-PC-S02 (FR-PC-S232).

EXPERIMENT L9-3

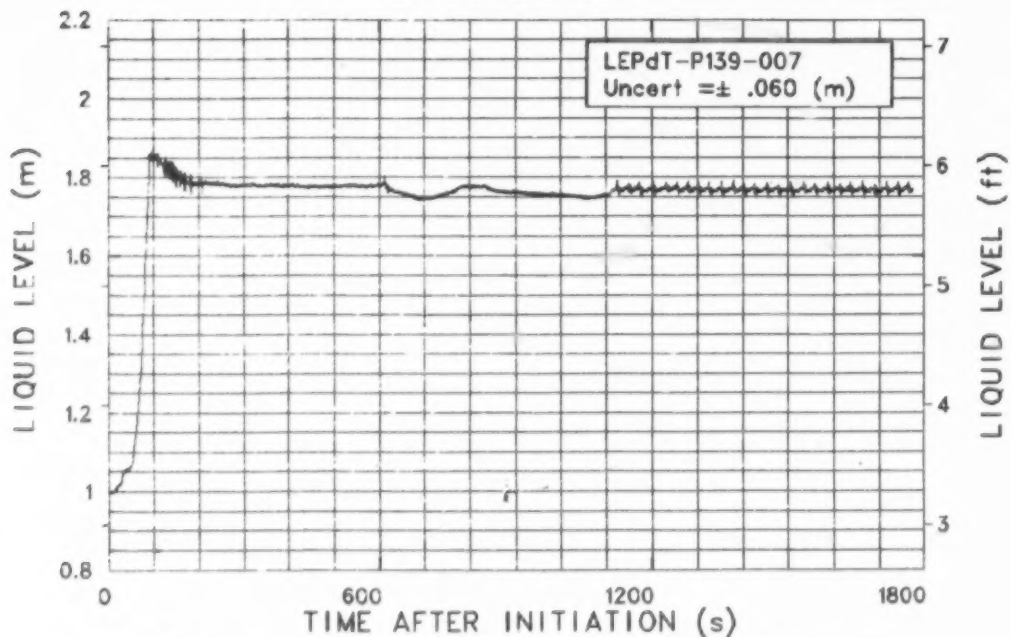


Figure 3C-5. Density compensated liquid level in pressurizer (LEPdT-P139-007) (uncertainty is 0.1 m from 0 to 150 s).
EXPERIMENT L9-3

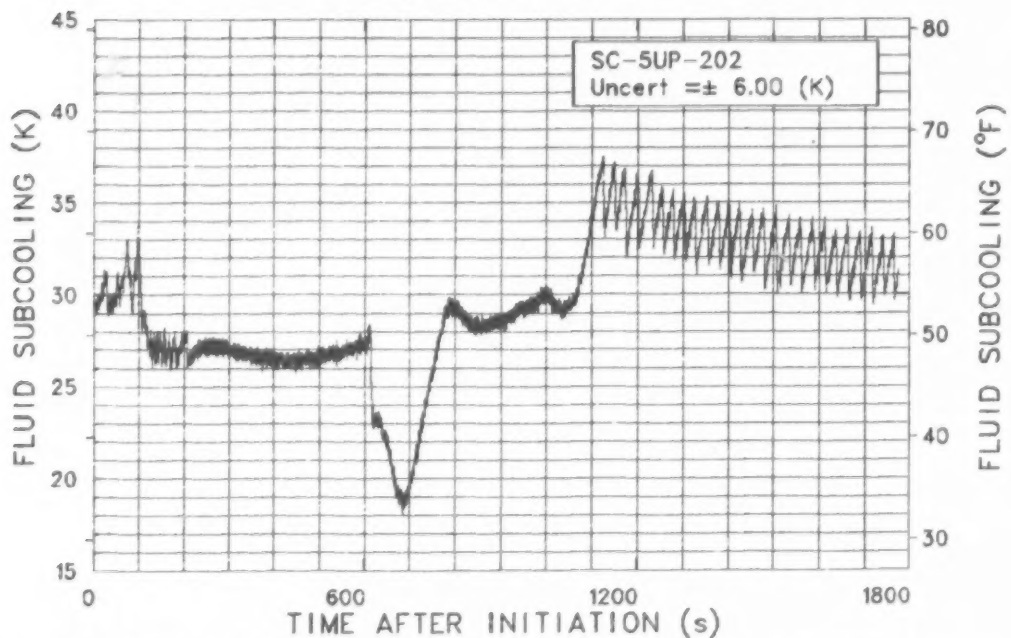


Figure 3C-6. Fluid subcooling in reactor vessel upper plenum (SC-5UP-202).

Variables With
Uncertainty Bands

EXPERIMENT L9-3

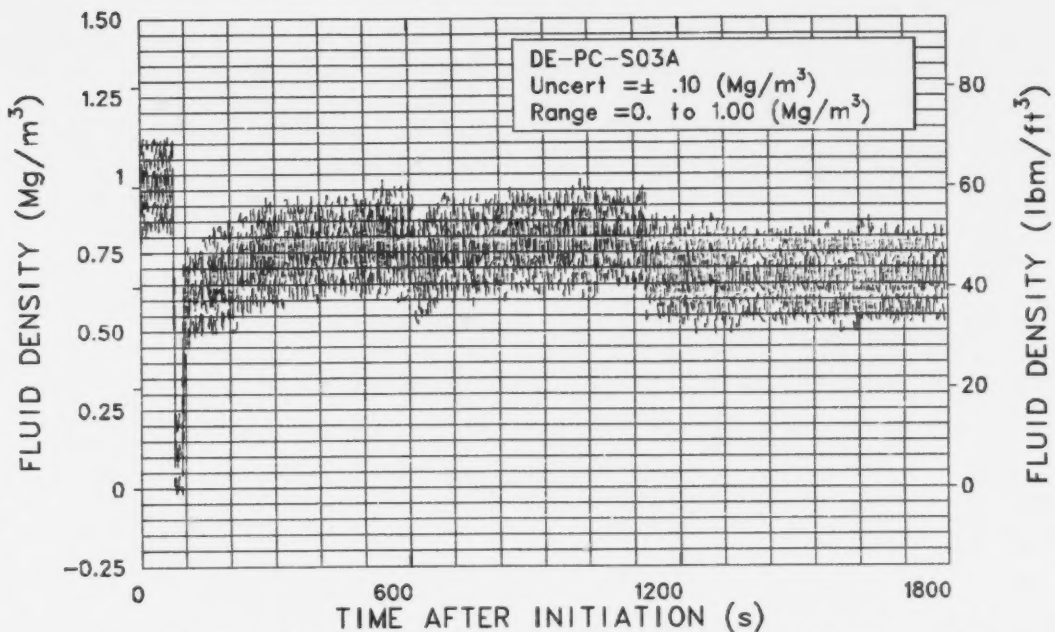


Figure 3U-1. Fluid density in intact loop pressure relief line upstream of experiment relief valve, chordal density (DE-PC-S03A).

EXPERIMENT L9-3

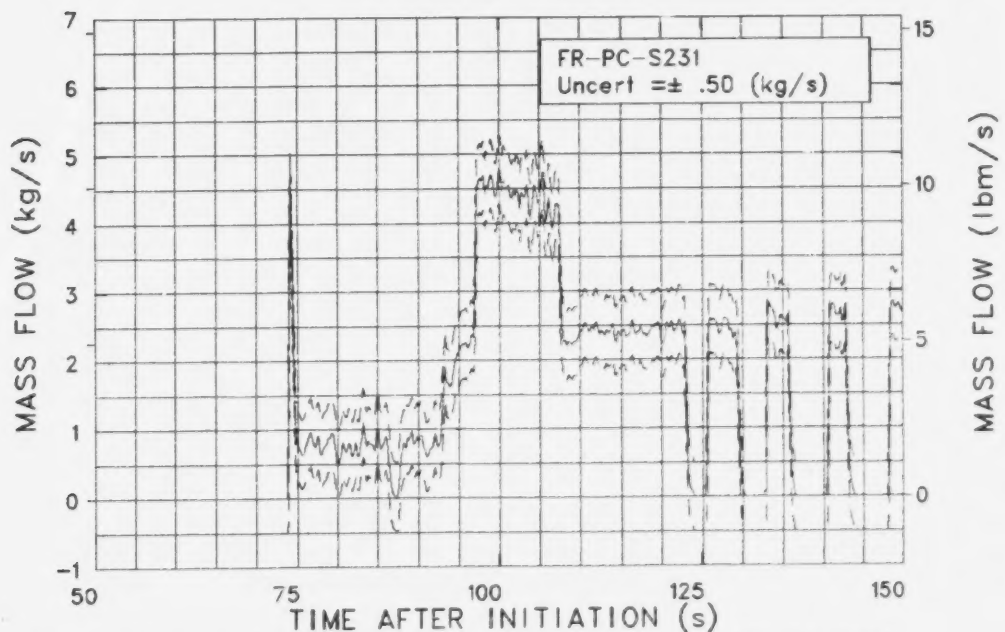


Figure 3U-2. Mass flow rate in pressure relief line (FR-PC-S231).

EXPERIMENT L9-3

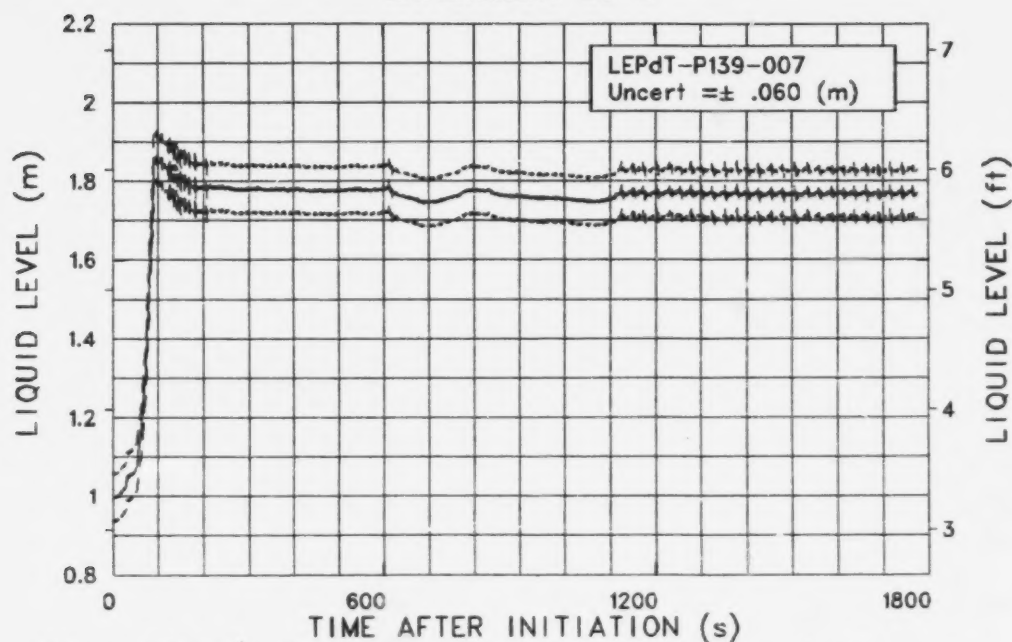


Figure 3U-3. Density compensated liquid level in pressurizer (LEPdT-P139-007) (uncertainty is 0.1 m from 0 to 150 s).
EXPERIMENT L9-3

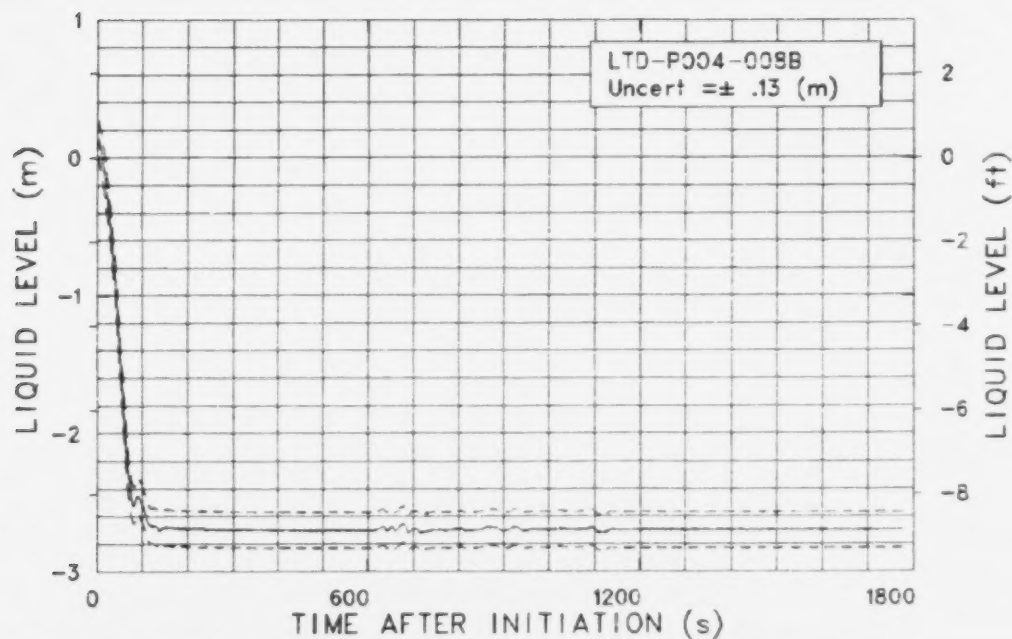


Figure 3U-4. Density compensated liquid level in steam generator (LTD-P004-008B).

EXPERIMENT L9-3

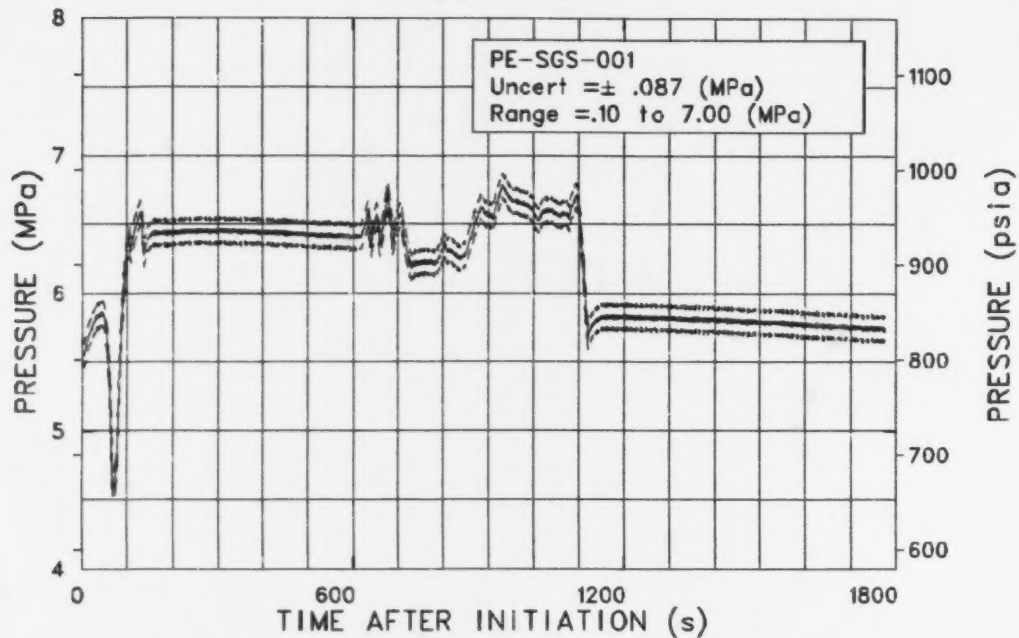


Figure 3U-5. Pressure in steam generator dome (PE-SGS-001).

EXPERIMENT L9-3

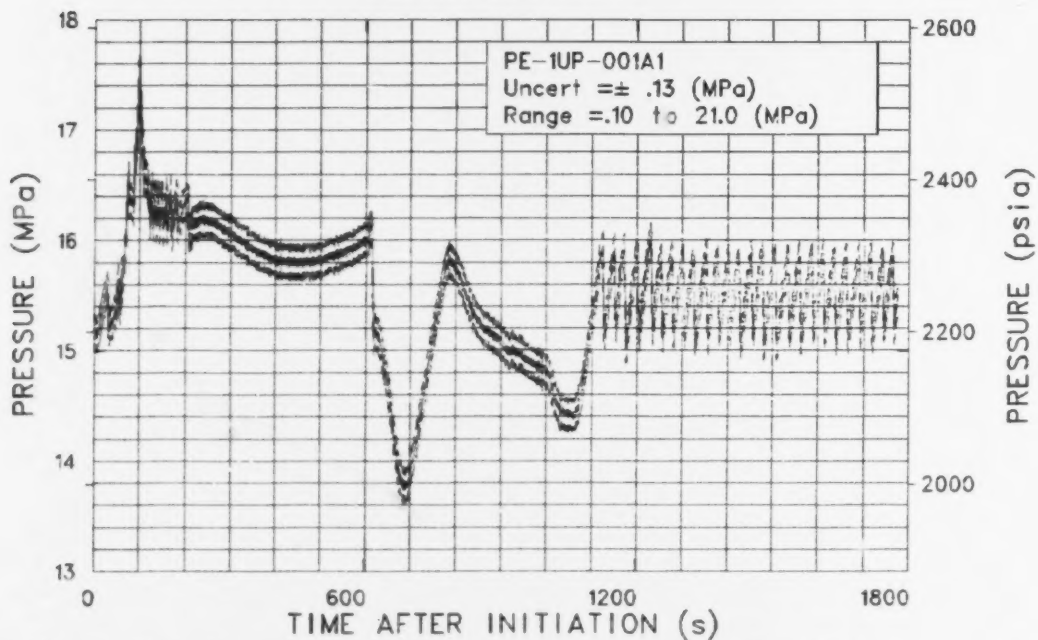


Figure 3U-6. Pressure above upper end box of Fuel Assembly 1 (PE-1UP-001A1).

EXPERIMENT L9-3

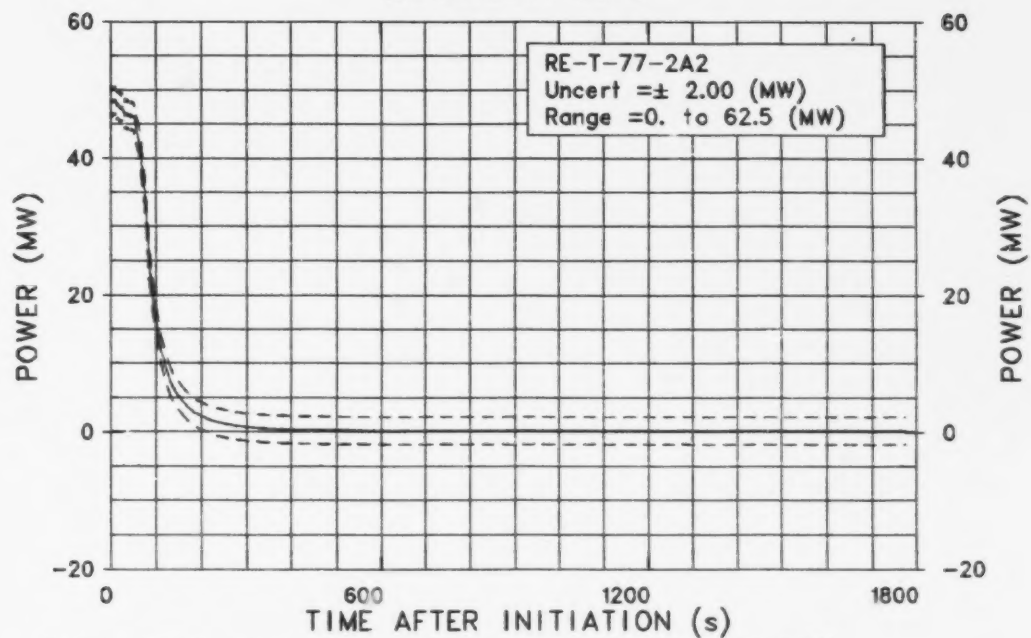


Figure 3U-7. Local average power, Channel B (RE-T-77-2A2).

EXPERIMENT L9-3

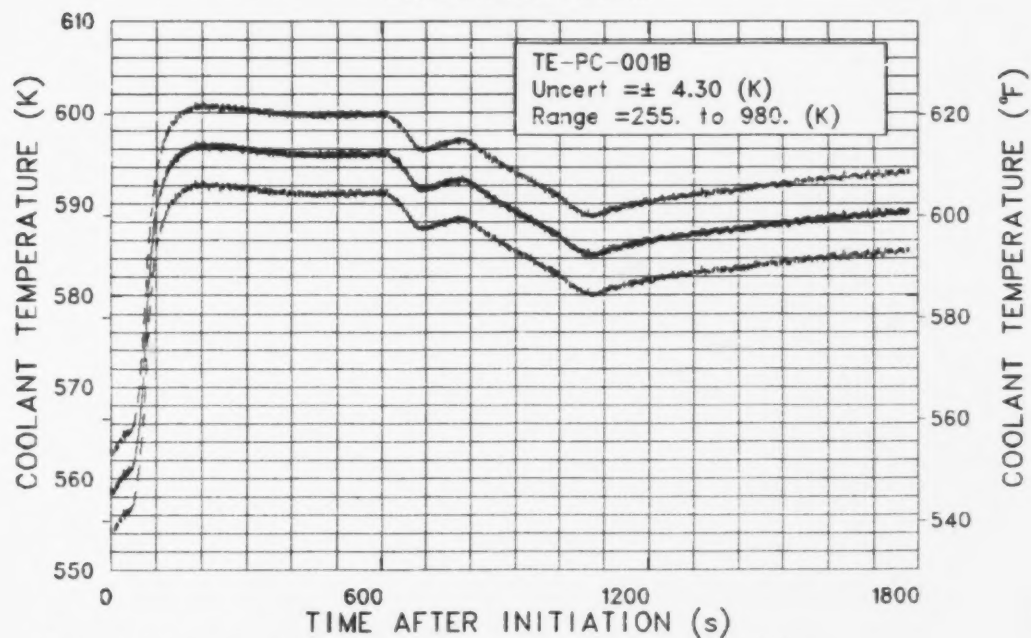


Figure 3U-8. Coolant temperature in intact loop cold leg (TE-PC-001B).

EXPERIMENT L9-3

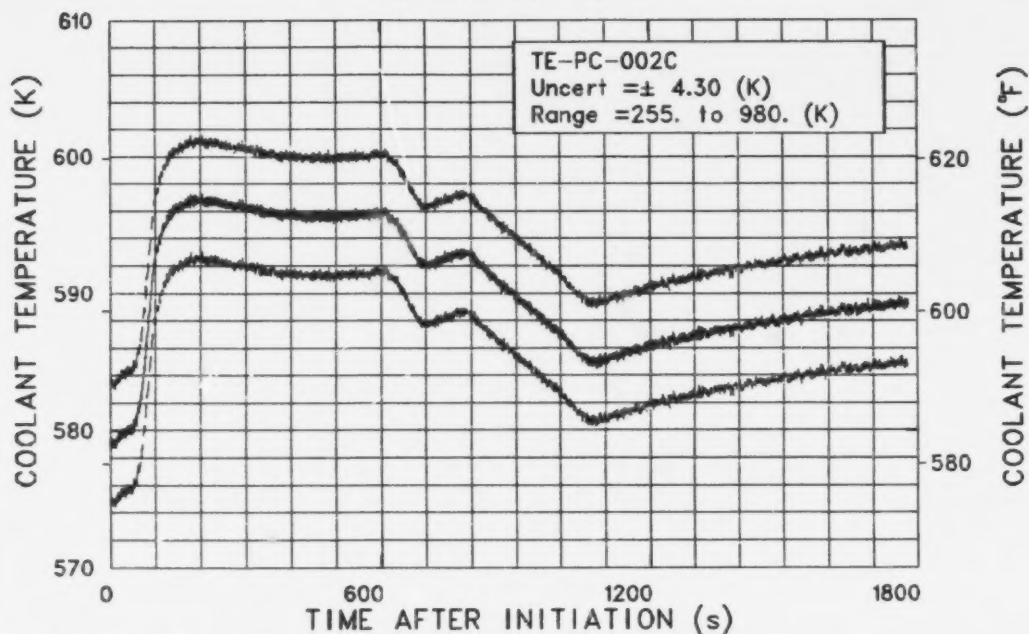


Figure 3U-9. Coolant temperature in intact loop hot leg (TE-PC-002C).

EXPERIMENT L9-3

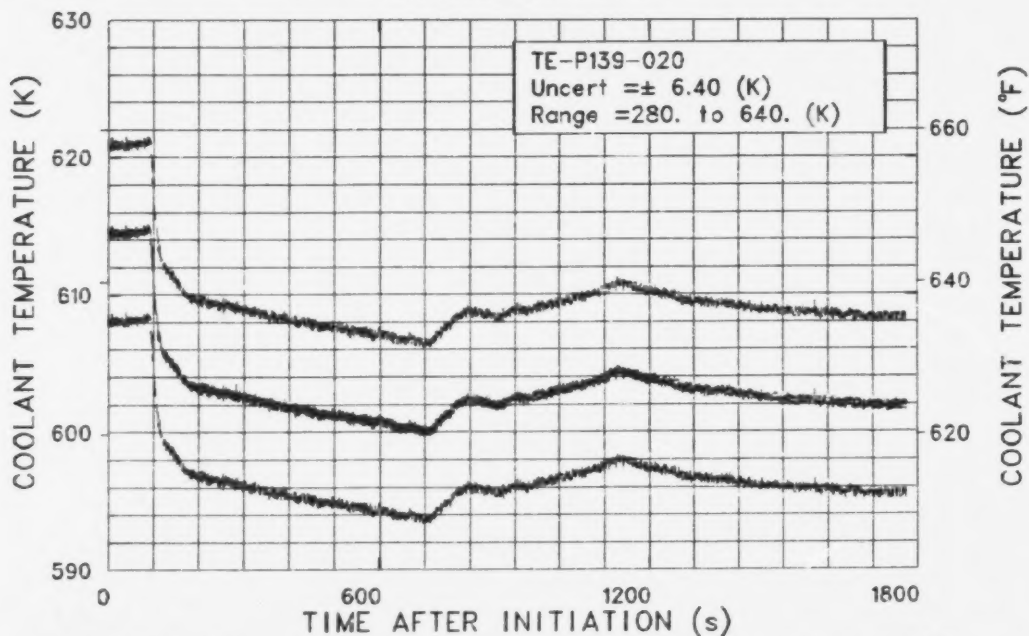


Figure 3U-10. Coolant temperature in intact loop pressurizer liquid space (TE-P139-020).

4. REFERENCES

1. D. L. Reeder, *LOFT System and Test Description (5.5-ft Nuclear Core 1 LOCEs)*, NUREG/CR-0247, TREE-1208, July 1978.
2. *Proposed Rulemaking to Amend 10 CFR Part 50 Concerning Anticipated Transients Without Scram (ATWS) Events*, USNRC SECY-80-409, September 1980.
3. F. S. Miyasaki, *Digital Data Acquisition Program*, ANCR-1250, August 1975.
4. *Proposed ANS Standard 5.1 Decay Heat Power in Light Water Reactors*, September 1978.

APPENDIX A
SYSTEM CONFIGURATION

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APPENDIX A

SYSTEM CONFIGURATION

The Loss-of-Fluid Test (LOFT) facility has been designed to simulate the major components and system responses of a commercial pressurized water reactor (PWR) during a loss-of-coolant accident. The experimental assembly includes five major subsystems which have been instrumented such that system variables can be measured and recorded during a loss-of-coolant experiment. The subsystems include: (a) the reactor vessel, (b) the intact loop, (c) the broken loop, (d) the blowdown suppression system, and (e) the emergency core cooling system (ECCS). The LOFT major components are shown in Figure A-1.

The LOFT reactor vessel has an annular downcomer, a lower plenum, lower core support plates, a nuclear core, and an upper plenum. The downcomer is connected to the cold legs of the intact and broken loops and contains two instrument stalks. The upper plenum is connected to the hot legs of the intact and broken loops. The core contains 1300 unpressurized nuclear fuel rods arranged in five square (15 x 15 assemblies) and four triangular (corner) fuel modules and is described in Reference A-1. The center assembly is highly instrumented. Two of the corner and one of the square assemblies are not instrumented. The fuel rods have an active length of 1.67 m and an outside diameter of 10.72 mm.

The fuel consists of UO_2 sintered pellets with an average enrichment of 4.0 wt% fissile uranium (^{235}U) and with a density that is 93% of theoretical density. The fuel pellet diameter and length are 9.29 and 15.24 mm, respectively. Both ends of the pellets are dished with the total dish volume equal to 2% of the pellet volume. The cladding material is zircaloy-4. The cladding inside and outside diameters are 9.48 and 10.72 mm, respectively.

The intact loop simulates three loops of a commercial four-loop PWR and contains a steam generator, two primary coolant pumps in parallel, a pressurizer, a venturi flowmeter, and connecting piping. A pressure relief line was installed for Experiment L9-3 from the pressurizer to the blowdown suppression tank (BST) in parallel with the plant power-operated relief valve (PORV) and safety relief valves (SRVs). This line contained a

combined experiment PORV and SRV. A single valve had two actuators so that it could open to either of two positions, representing a PORV flow area or a combined PORV and SRV flow area. In calibration testing, the valve provided a flow of 0.30 ± 0.05 kg/s saturated steam at 7.4 MPa in the PORV position, and a flow of 0.55 ± 0.10 kg/s saturated steam at 6.0 MPa in the combined PORV and SRV position. The target flow rates were 0.66 ± 0.10 kg/s saturated steam at 16.20 MPa and 1.52 ± 1.10 kg/s saturated steam at 17.24 MPa for the PORV and combined positions, respectively.

The broken loop consists of a hot leg and a cold leg that are connected to the reactor vessel and the BST header. Each leg consists of a break plane orifice, a quick-opening blowdown valve (QOBV), a recirculation line, an isolation valve, and connecting piping. The recirculation lines establish a small flow from the broken loop to the intact loop and are used to warm up the broken loop. In this experiment, the QOBVs and isolation valves remained closed. The broken loop hot leg also contains a simulated steam generator and a simulated pump. These simulators have hydraulic orifice plate assemblies which have similar (passive) resistances to flow as an active steam generator and a pump. The simulators were flanged off from the hot leg during Experiment L9-3.

The blowdown suppression system is comprised of the BST header, the BST, the nitrogen pressurization system, and the BST spray system. The blowdown header is connected to the suppression tank downcomers which extend inside the tank below the water level. The header is also directly connected to the BST vapor space to allow pressure equilibration. The nitrogen pressurization system is supplied by the LOFT inert gas system and uses a remote controlled pressure regulator to establish and maintain the specified BST initial pressure. The spray system consists of a centrifugal pump that discharges through a heatup heat exchanger and any of three spray headers or a pump recirculation line that contains a cooldown heat exchanger. The spray pump suction can be aligned to either the BST or the borated water storage tank. The three spray headers have flow rate capacities of 1.3, 3.8, and

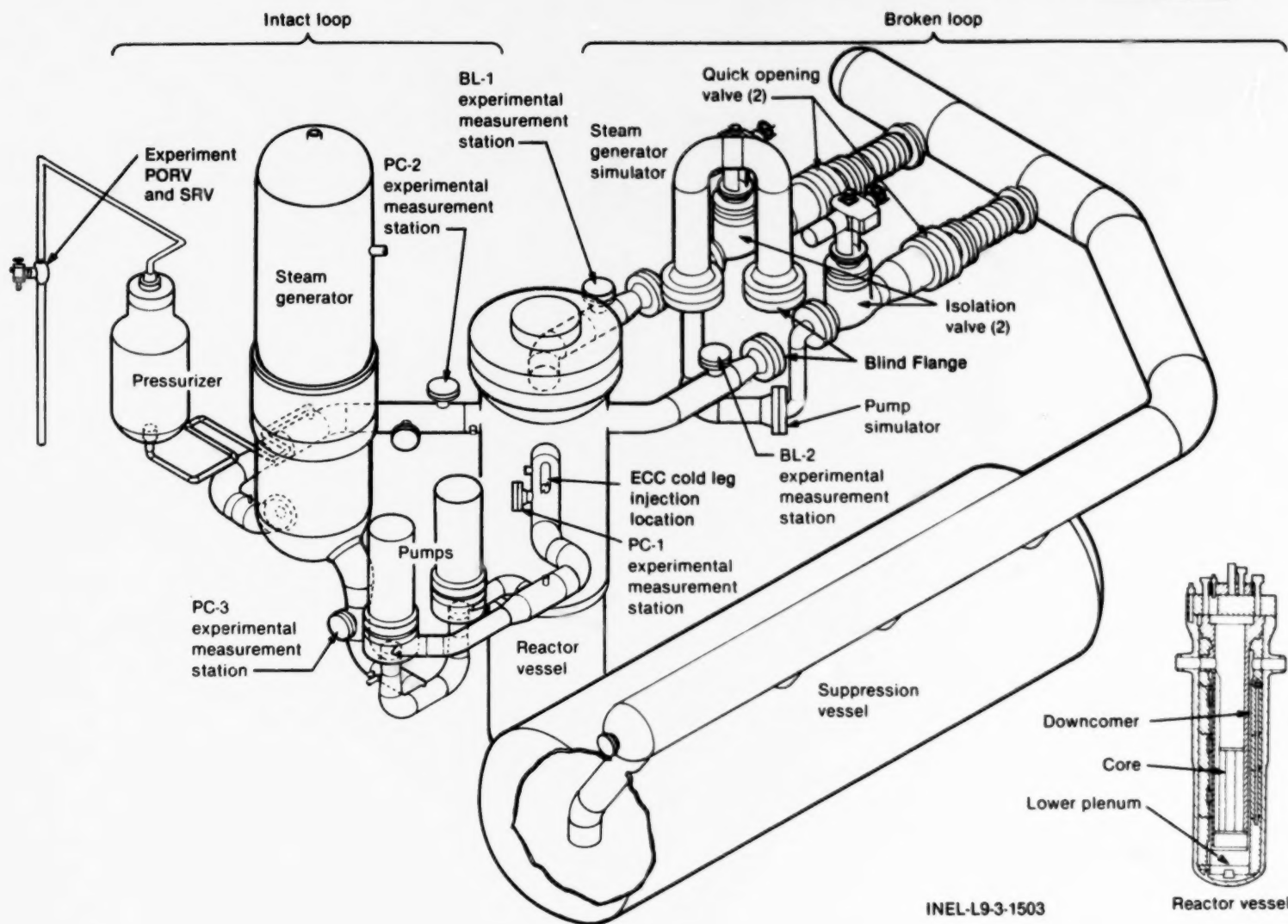


Figure A-1. LOFT major components.

13.9 L/s, respectively, and are located in the BST along the upper centerline. For Experiment L9-3, the BST header was not used to carry flow. Break flow entered the BST via a 4-in. pipe which was connected to the north end of the BST and discharged below the water level. The BST spray pump suction was connected to the BST and the liquid in the BST was recirculated at full spray pump capacity.

The LOFT ECCS simulates the ECCS of a commercial PWR. It consists of two accumulators, a high-pressure injection system (HPIS), and a low-

pressure injection system (LPIS). Each system is arranged to inject scaled flow rates of emergency core coolant directly into the primary coolant system. HPIS flow was directed to the downcomer during the recovery phase of Experiment L9-3.

Reference

- A-1. M. L. Russell, *LOFT Fuel Modules Design, Characterization, and Fabrication Program*, TREE-NUREG-1131, June 1977.

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APPENDIX B
MEASUREMENTS AND INSTRUMENTATION

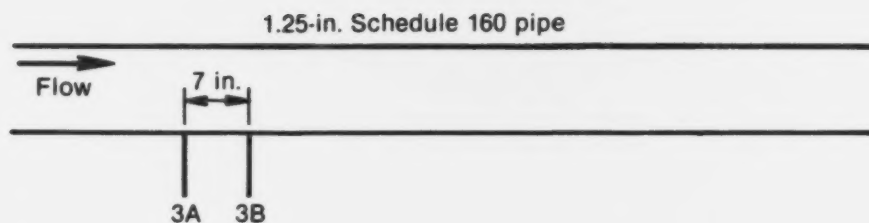
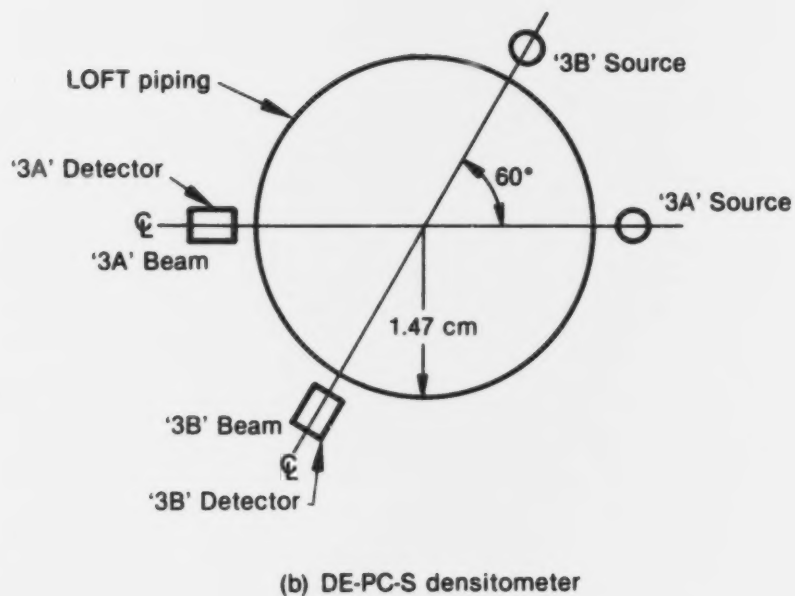
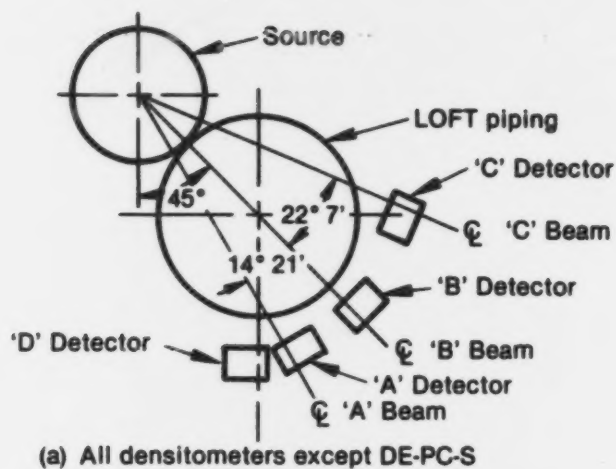
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APPENDIX B

MEASUREMENTS AND INSTRUMENTATION

The Loss-of-Fluid Test (LOFT) instrumentation system is designed to measure and record the important parameters and events that occur during an experiment. The types of instruments used are summarized below.

1. Temperatures at all major locations in the system are obtained from thermocouples and resistance temperature detectors.
 2. Pressure measurements are obtained primarily from strain gauge transducers with pressure transmission lines connecting the transducers to the measurement points. Fuel plenum pressures are measured by eddy current transducers that measure the displacement of a target in the fuel rod.
 3. Differential pressures are measured by strain gauge transducers with double chambers. The transducers are externally located and connected to the measurement points by pressure transmission lines.
 4. Flow velocity is measured by turbine flowmeters.
 5. Momentum flux is measured by drag discs and drag screens. The data presented for fluid velocity and momentum flux are based on the following flow areas at the instrument locations:
- | Instrument | Flow Area (m ²) |
|--|-----------------------------|
| FE-1ST-1 and -2
ME-1ST-1 and -2 | 0.141 |
| FE-5LP-1 and 2
ME-5LP-1 and 2 | 0.106 |
| FE-5UP-1
ME-3UP-1 and ME-5UP-1 | 0.125 |
| FE-PC-S2
ME-PC-S2 | 0.0007 |
| FE-PC-1A, -1B, and -1C
ME-PC-1A, -1B, and -1C
FE-PC-2A, -2B, and -2C
ME-PC-2A, -2B, and -2C | 0.0634 |
6. Fluid density is measured by gamma densitometers. All but the pressure relief line gamma densitometer consist of a ⁶⁰Co source and three detectors as shown in Figure B-1. Each of the three detectors sees a collimated gamma ray beam, emitted from a single source, that has passed through the pipe. Each of these densitometers also has a detector (D) located so that it measures background radiation continuously. The relief line gamma densitometer has two ²⁴¹Am sources and two detectors. Each detector sees a collimated gamma ray beam emitted from a single source. The two gamma ray beams pass horizontally through a vertical section of the pressure relief line. They are 60° apart from each other radially and 17.8 cm apart axially. The attenuation of the gamma rays varies inversely with the density of the fluid in the pipe. The DE-PC-3 and DE-PC-S3 densitometers are located in vertical piping; the rest of the densitometers are located in horizontal piping. Figure B-1 shows the gamma densitometer configuration relative to the piping.
 7. Liquid levels are obtained by means of (a) differential pressure transducers in the pressurizer, accumulator, steam generator secondary side, pump suction piping, reactor vessel upper plenum, and blowdown suppression tank (BST); and (b) liquid detectors which sense the conductivity of the fluid near each of a series of electrical contacts in the reactor vessel.
 8. Control rod position is indicated by means of proximity switches. The circuitry associated with the proximity switches controls a set of lamps. Each set of lamps consists of a "rod bottom" lamp and four "rod location" lamps. The rod bottom lamp lights only when the control rod is bottomed. Each rod location lamp lights as the leadscrew on the control rod passes its switch position during withdrawal, and it remains lit whenever the leadscrew is above this position.



(c) Axial detector location for DE-PC-S

INEL-L9-3-2503

Figure B-1. Relation of source and detectors to pipe for gamma densitometers.

9. Valve positions (analog indication from 0 to 100% of opening) are measured by either resistance potentiometers or differential transformers.
10. Mechanical pump speed is measured by an eddy current displacement transducer that uses a slotted metallic target attached to the top of the pump motor shaft. The target contains six asymmetrical slots so that pump speed can be determined. Electrical pump power is measured by a watt transducer.
11. The steady-state local linear heat generation rate is measured by self-powered neutron detectors and is also determined from neutron flux measurements taken with traversing in-core probes. The two types of instruments are described below.
 - a. Each self-powered neutron detector consists of a cylindrical ^{59}Co emitter, a layer of aluminum oxide for electrical insulation, and an outer sheath of Inconel. The cable connected to the detector consists of two Inconel wires in an Inconel sheath with magnesium oxide insulation. One of the wires is connected to the cobalt emitter and the other is open ended. The open-ended wire gives a background subtraction signal to compensate for the radiation sensitivity of the cable.
 - b. A traversing in-core probe measures neutron flux at four guide tube locations in the core. This instrument consists of a ^{235}U fission chamber attached to a flexible cable and its own data recording system. The probe was withdrawn and stored outside the core prior to experiment initiation.
12. Reactor power is measured by ionization chambers.

The data acquisition and visual display system is used to record measured data from the various instrumentation systems on a combination of digital recorders, wide-band frequency modulation (FM) tape recorders, and oscillographic recorders.^{B-1} Redundant records are made where

use dictates more than one recording mode or where an extra measure of assurance is desired for critical measurements.

A digital computer is used to collect the experiment data in a multiplexed format at the LOFT facility and to perform equipment calibrations, posttest data reduction, and plotting.^{B-2} The recorded FM data are converted into digital form, and then demultiplexed to be compatible with the CDC CYBER 176 computer system.

The CDC CYBER 176 computer system is used to further reduce the data. Calibration factors are first applied to produce data plots in engineering units so that engineering specialists can examine each channel for discrepancies or unexpected events. Where possible, instrument channel outputs and computed variables are compared with previous experiments, corresponding parameter channels, and calculated quantities. Instruments are labeled as "Qualified" if the measurement comparisons are determined to be within the accuracy of the particular instrument.

Most transducers were calibrated under laboratory conditions prior to installation in the LOFT system. Verification of calibration constants is accomplished by special tests performed during heatup and by analysis of initial conditions data. In addition, postexperiment checks are performed to pinpoint questionable data and to verify data consistency. Appendix C discusses the techniques used to perform data consistency checks.

Figure B-2 shows a piping schematic indicating instrument locations. Table B-1 gives the nomenclature for LOFT experimental and process instrumentation. Both types of instrumentation are included in this report. Thermocouples and neutron flux detectors located in the nuclear core have special identification. Most of these transducers have been given identification numbers which identify the type of transducer and the location within the core as follows:

Transducer location (inches from bottom of fuel rod) _____
 Fuel assembly row _____
 Fuel assembly column _____
 Fuel assembly number _____
 Transducer type _____

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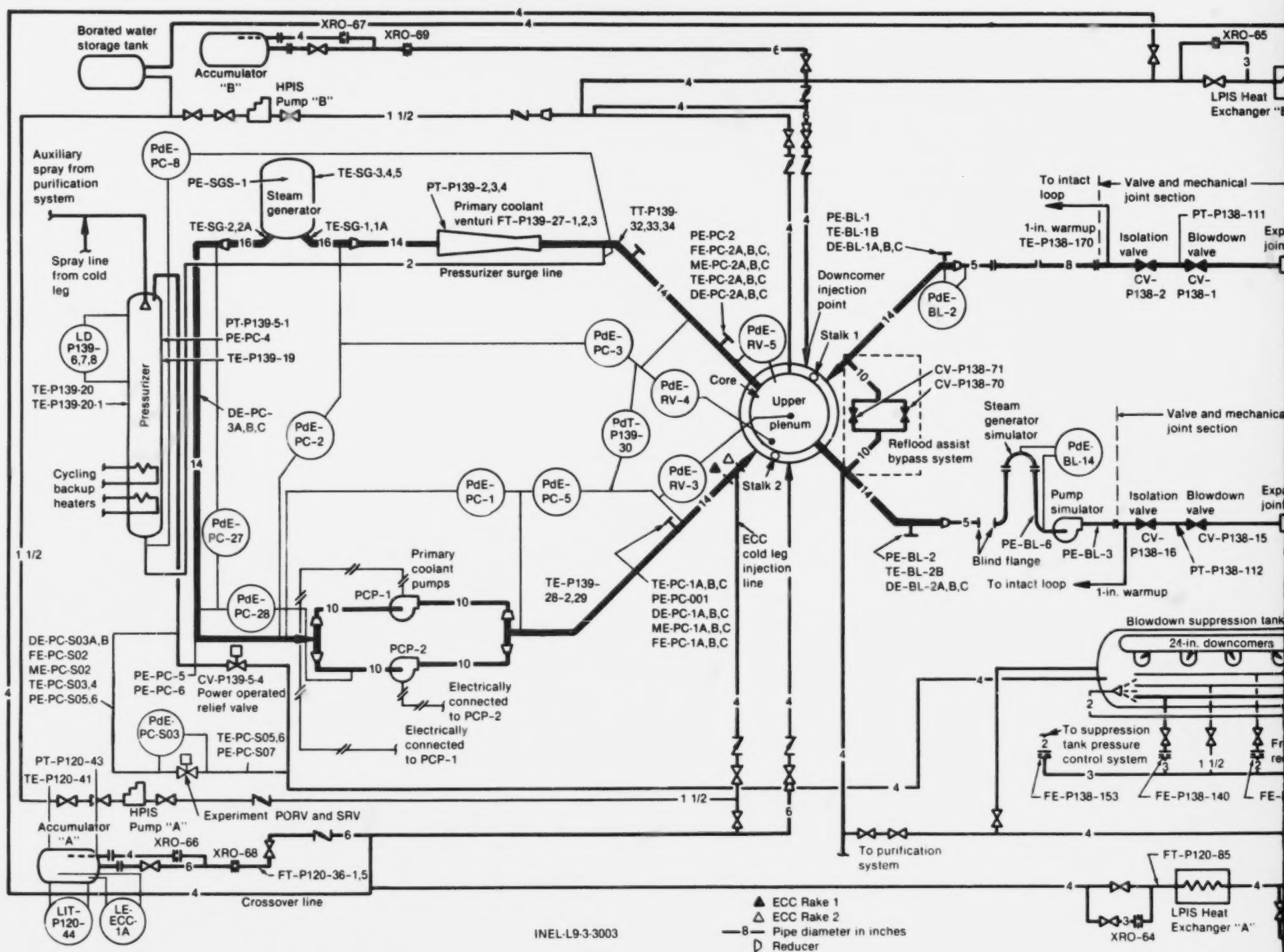


Figure B-2. LOFT piping schematic with instrumentation.

TABLE B-1. NOMENCLATURE FOR LOFT INSTRUMENTATION

<u>Designations for the Different Types of Experimental Instruments</u>	
AE	Accelerometer
DE	Gamma densitometer
DIE	Displacement element
FE	Coolant flow element
LE	Coolant level element
ME	Momentum flux detector
NE	Neutron detector
PCP	Primary coolant pump
PdE	Differential pressure element
PE	Pressure element
RPE	Pump speed element
TC,TE,TF,TM,	Temperature element
TP	
<u>Designations for the Different Experimental Systems, Except the Core</u>	
BL	Broken loop
LP	Lower plenum
PC	Primary coolant intact loop
PC-S	Spool piece in pressure relief line
RV	Reactor vessel
SG	Steam generator
SGS	Steam generator secondary
1ST	Downcomer Stalk 1
2ST	Downcomer Stalk 2
SV	Suppression tank
UP	Upper plenum
<u>Designations for the Different Types of Process Instruments</u>	
CV	Control valve
FE	Flow element
FT	Flow transmitter
LD	Density-compensated liquid level element
LIT	Level-indicating transmitter (not density compensated)
LT	Liquid level transmitter (not density compensated)
PdT	Differential pressure transmitter
PT	Absolute pressure transmitter
RE	Radiation element
TE	Temperature element
TT	Temperature transmitter
<u>Designations for the Different Systems Associated with Process Instruments</u>	
P004	Secondary coolant system
P120	Emergency core cooling system
P128	Primary coolant addition and control system and high-pressure injection system
P138	Broken loop and pressure suppression system
P139	Intact loop
P141	Primary component cooling system
T-77,T-87	Power range

The fuel plenum temperature and pressure measurement identification numbers do not include the height above the bottom of the fuel rod.

Figures B-3 and B-4 show isometric views of the major system components with instrument locations indicated. Figures B-5 through B-17 give more specific locations for instruments located on individual components. Reference B-3 may be consulted if additional details of instrument design and locations are desired.

Table B-2 lists instruments that were available for use in LOFT Experiment L9-3. Included are the instrument location, range, recording frequency, initial condition uncertainty, and uncertainty at specific readings. The "Comments" column contains information relative to the usability of the data. No entry under the "Comments" column means that the instrument was recorded, but the data were not reviewed or presented.

References

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- B-2. N. L. Norman, *LOFT Data Reduction*, ANCR-1251, August 1975.
- B-3. D. L. Reeder, *LOFT System and Test Description (5.5-ft Nuclear Core 1 LOCEs)*, NUREG/CR-0247, TREE-1208, July 1978.
- B-4. G. D. Lassahn, *LOFT Experimental Measurements Uncertainties Analyses, Volume XVI, LOFT Three-Beam Gamma Densitometer System*, TREE-NUREG-1089, February 1978.
- B-5. G. D. Lassahn, *LOFT Experimental Measurements Uncertainty Analyses, Volume XVIII, Radiation-Hardened Gamma Densitometer*, NUREG/CR-0169, EGG-2037, September 1980.
- B-6. G. L. Biladeau, *LOFT Experimental Measurements Uncertainty Analyses, Volume VI, LOFT Linear Variable Differential Transformer Displacement Transducer Uncertainty Analysis*, TREE-NUREG-1089, February 1978.
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- B-9. L. D. Goodrich, *LOFT Experimental Measurements Uncertainty Analyses, Volume XV, LOFT Primary Coolant Pump Speed Measurement Uncertainty Analysis*, TREE-NUREG-1089, April 1978.
- B-10. G. D. Lassahn, *LOFT Experimental Measurements Uncertainty Analyses, Volume XII, Differential Pressure Measurements*, NUREG/CR-0169, EGG-2037, August 1981.
- B-11. S. Ploger, *LOFT Experimental Measurements Uncertainty Analyses, Volume X, Absolute Pressure Measurement Uncertainty Analysis*, NUREG/CR-0169, EGG-2037, September 1981.
- B-12. G. D. Lassahn, *LOFT Experimental Measurements Uncertainty Analyses, Volume XIII, Temperature Measurements*, NUREG/CR-0169, EGG-2037, March 1982.

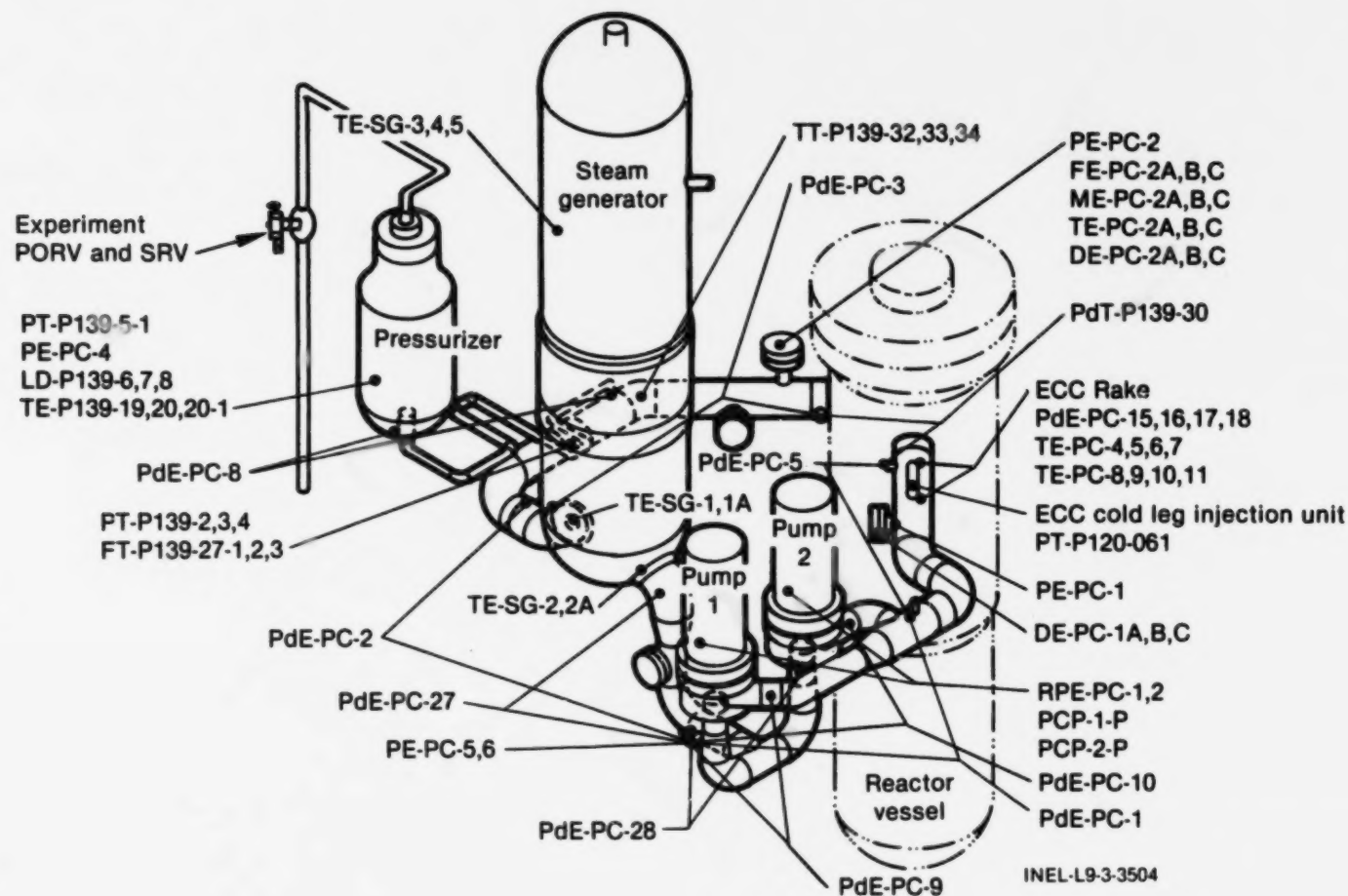
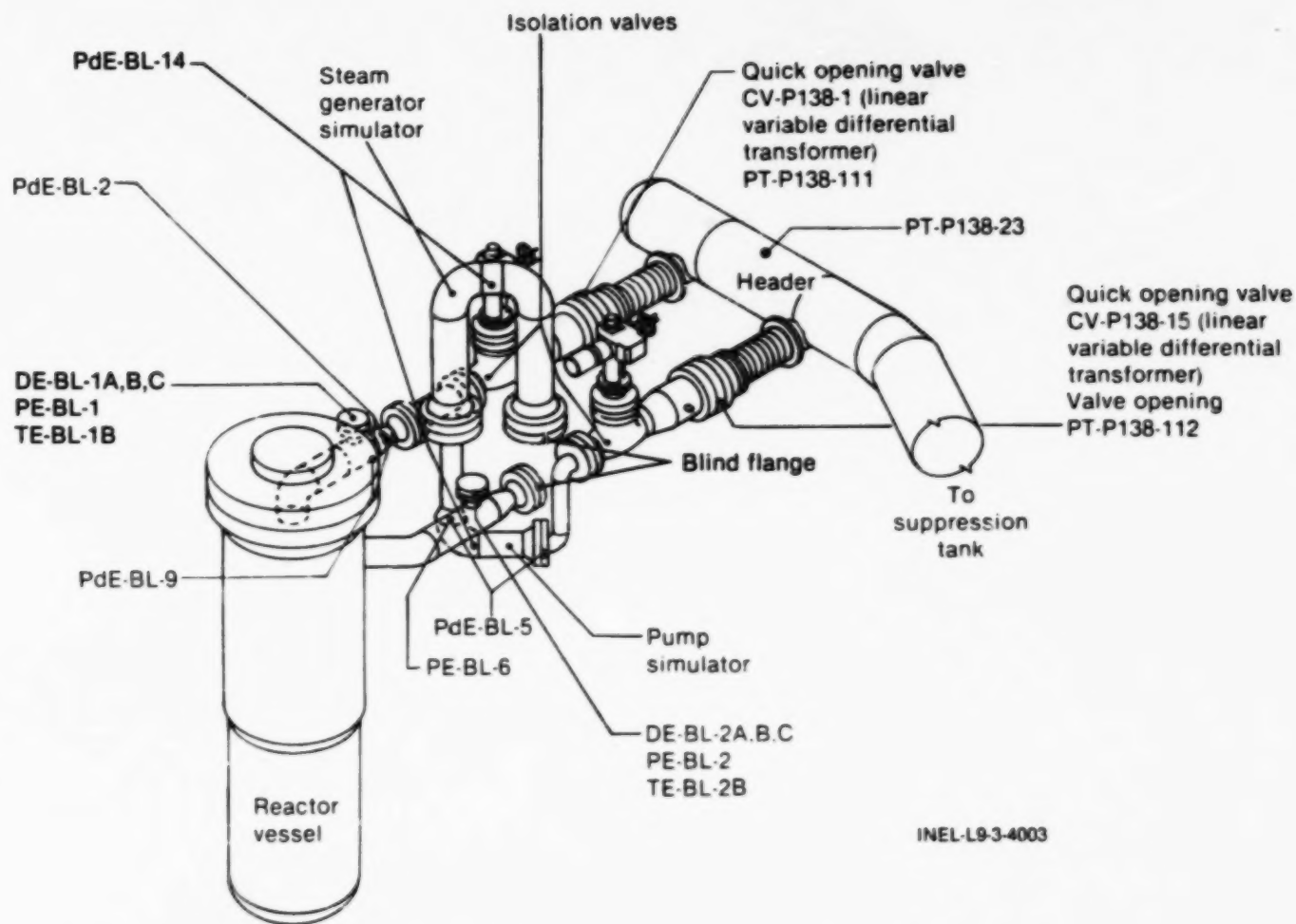


Figure B-3. LOFT thermal-hydraulic instrumentation for intact loop.



INEL-L9-3-4003

Figure B-4. LOFT thermal-hydraulic instrumentation for broken loop.

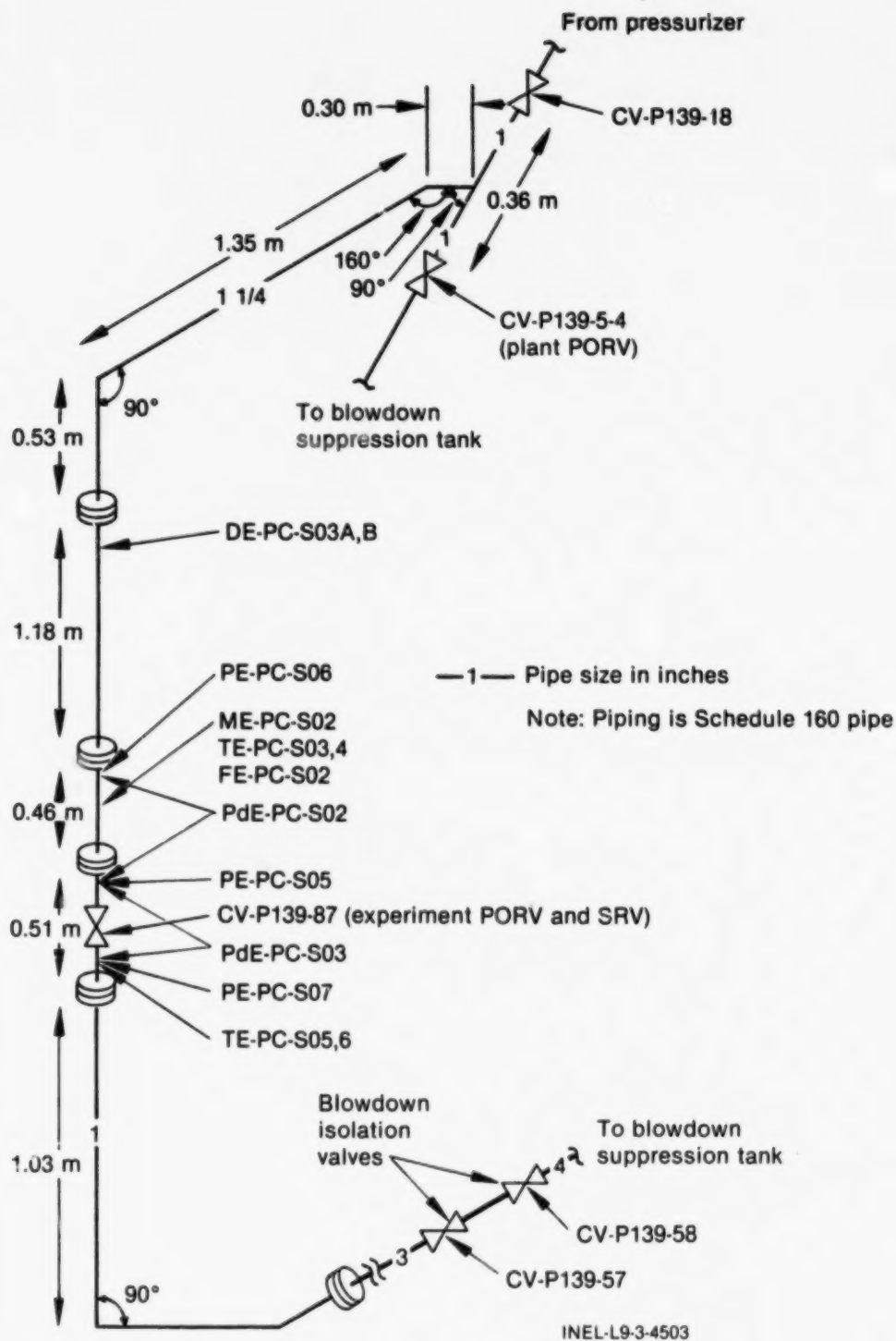


Figure B-5. LOFT thermal-hydraulic instrumentation for pressure relief line.

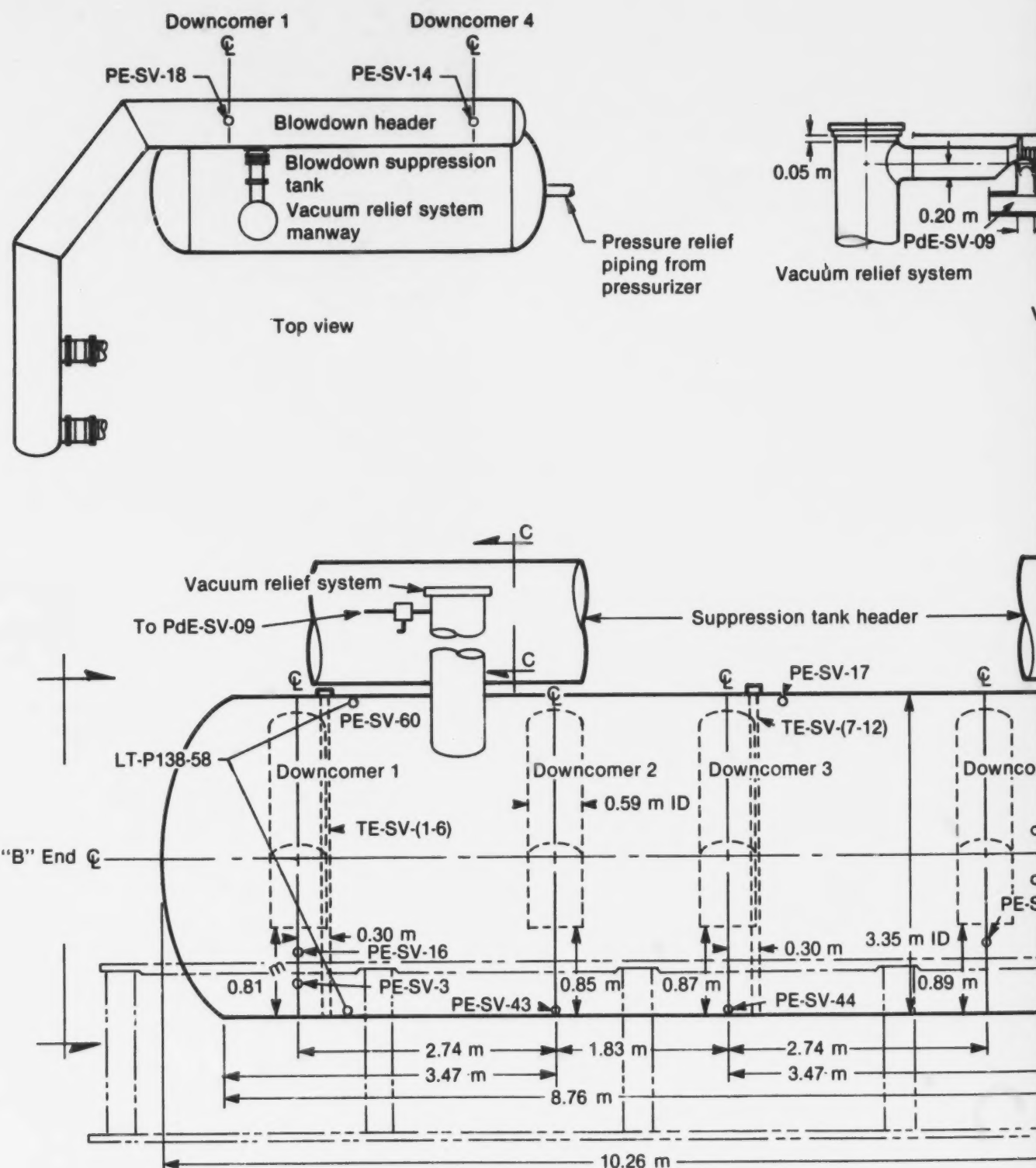
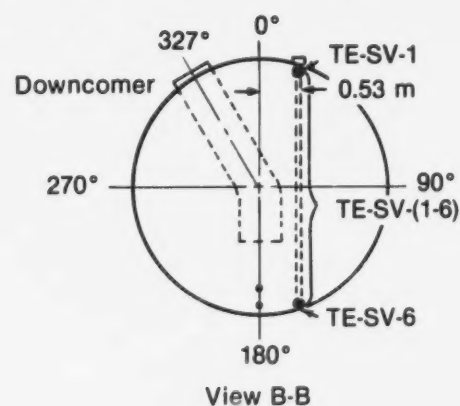
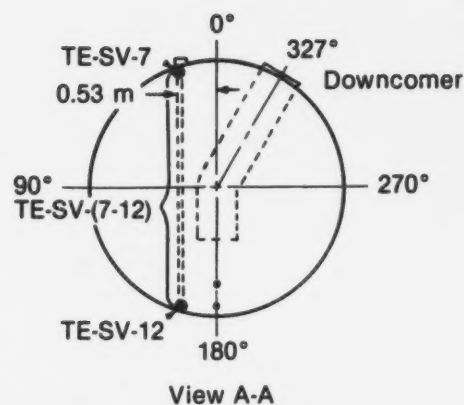
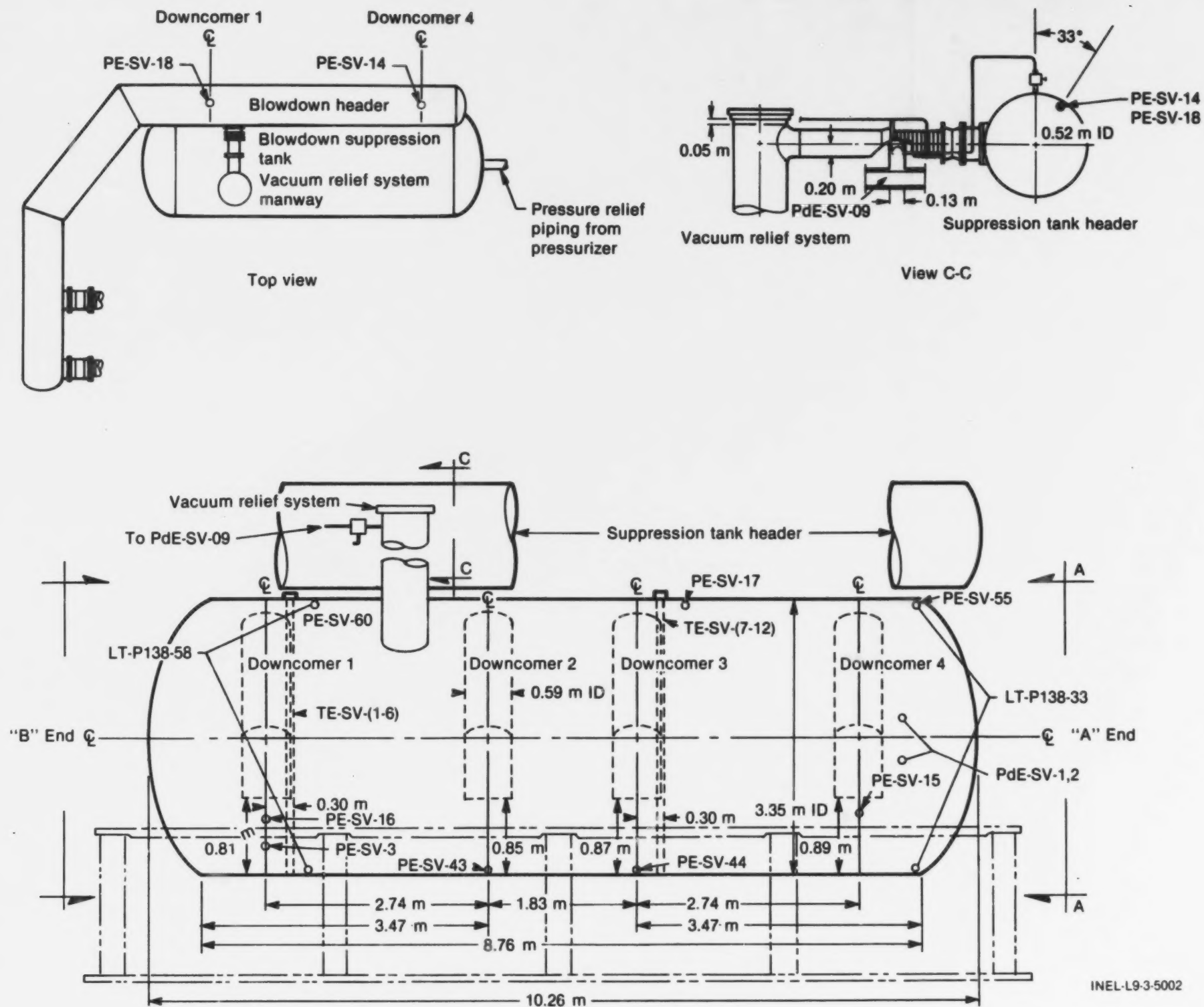


Figure B-6. LOFT blowdown suppression tank instrumentation.



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Figure B-6. LOFT blowdown suppression tank instrumentation.

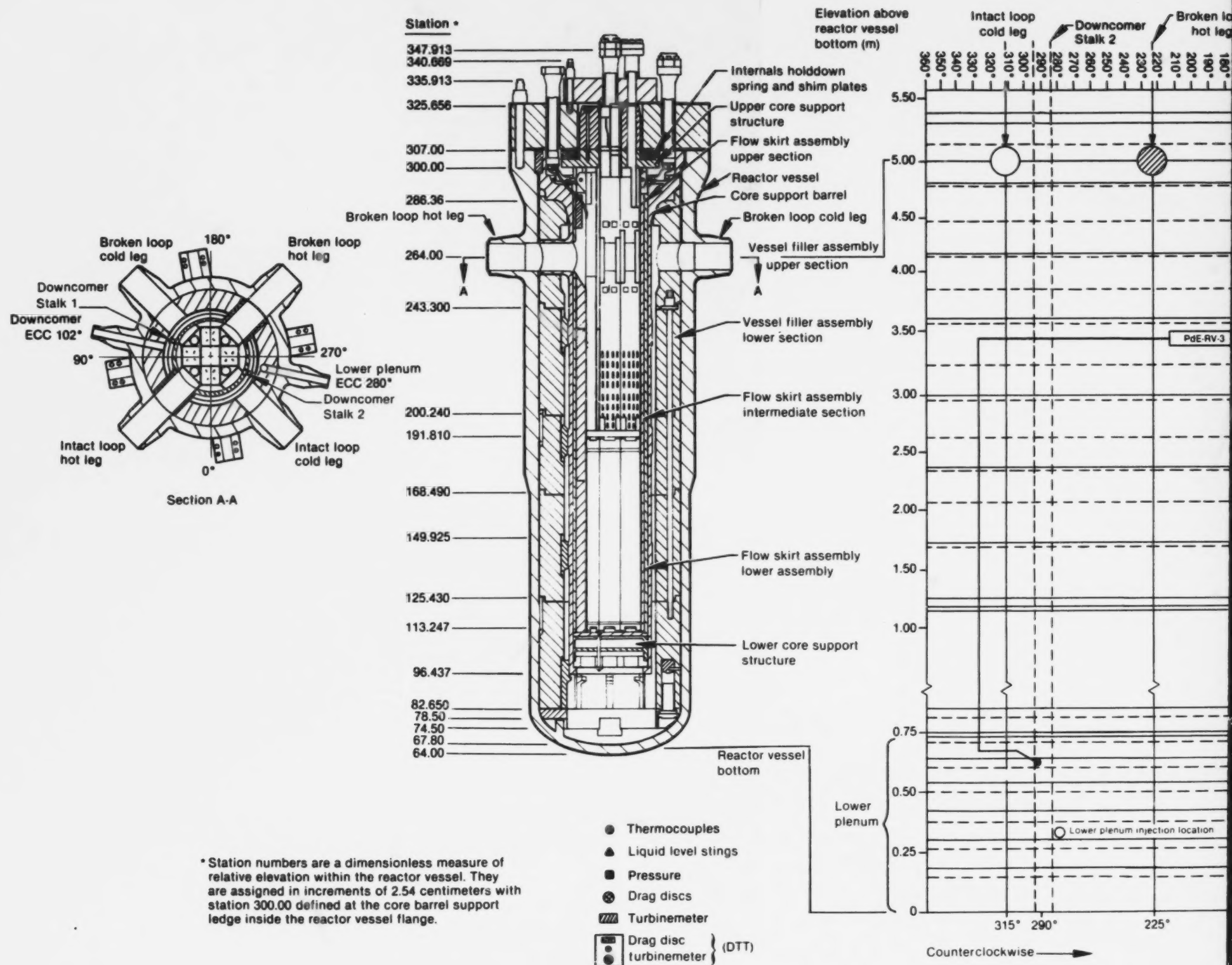


Figure B-7. LOFT reactor vessel instrumentation.

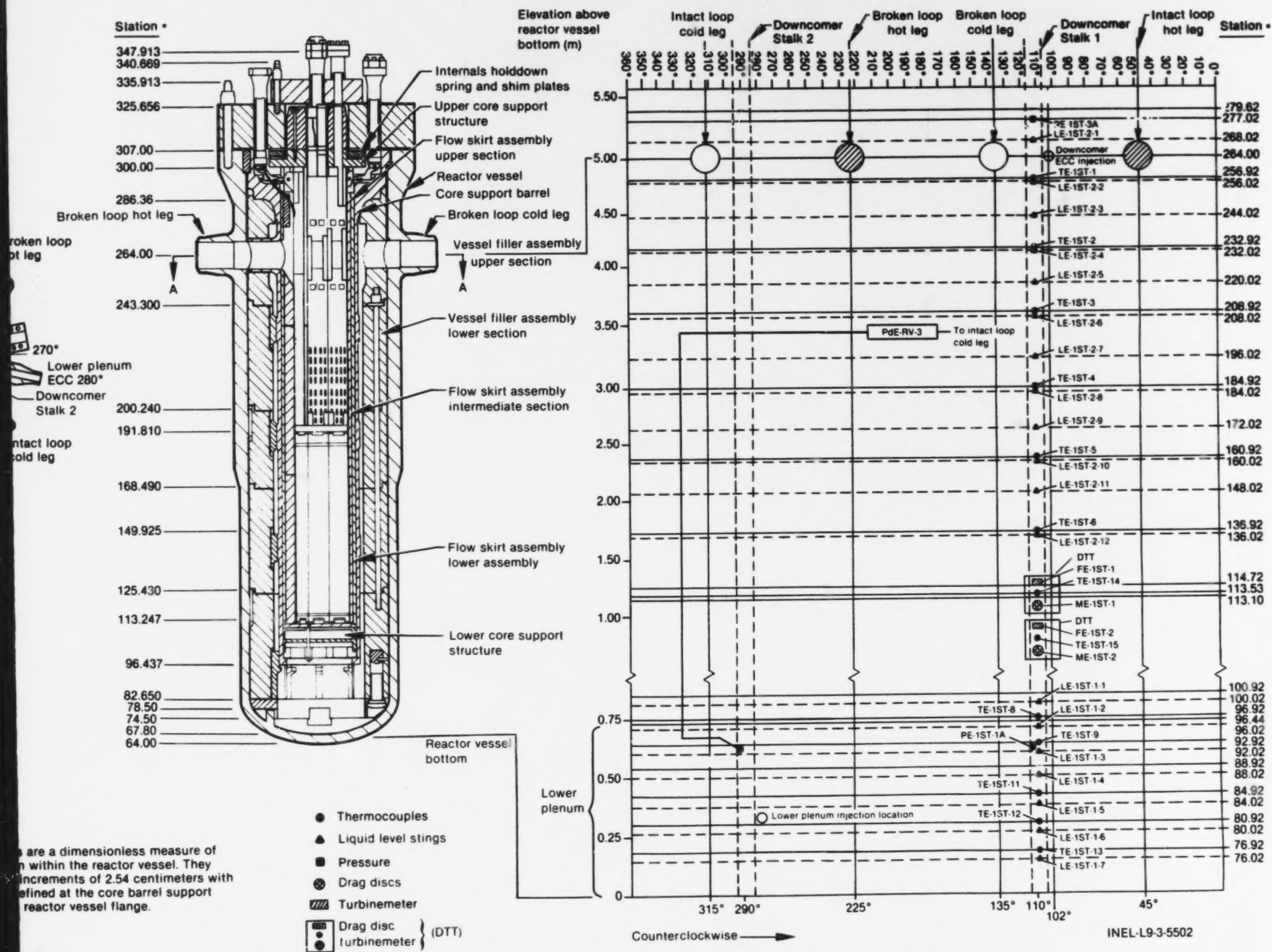


Figure B-7. LOFT reactor vessel instrumentation.

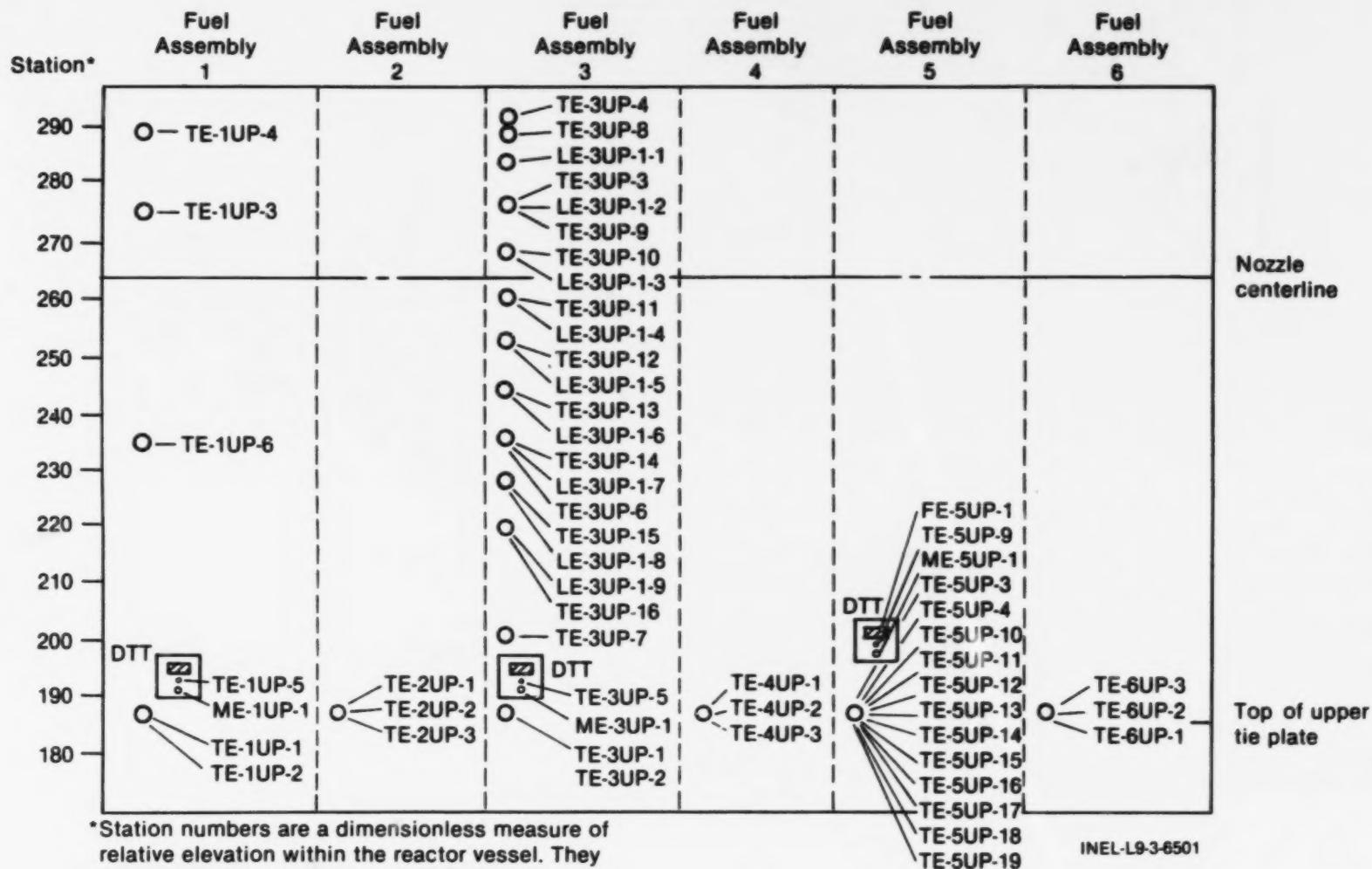


Figure B-8. LOFT reactor vessel upper plenum DTT, LE, and TE elevations.

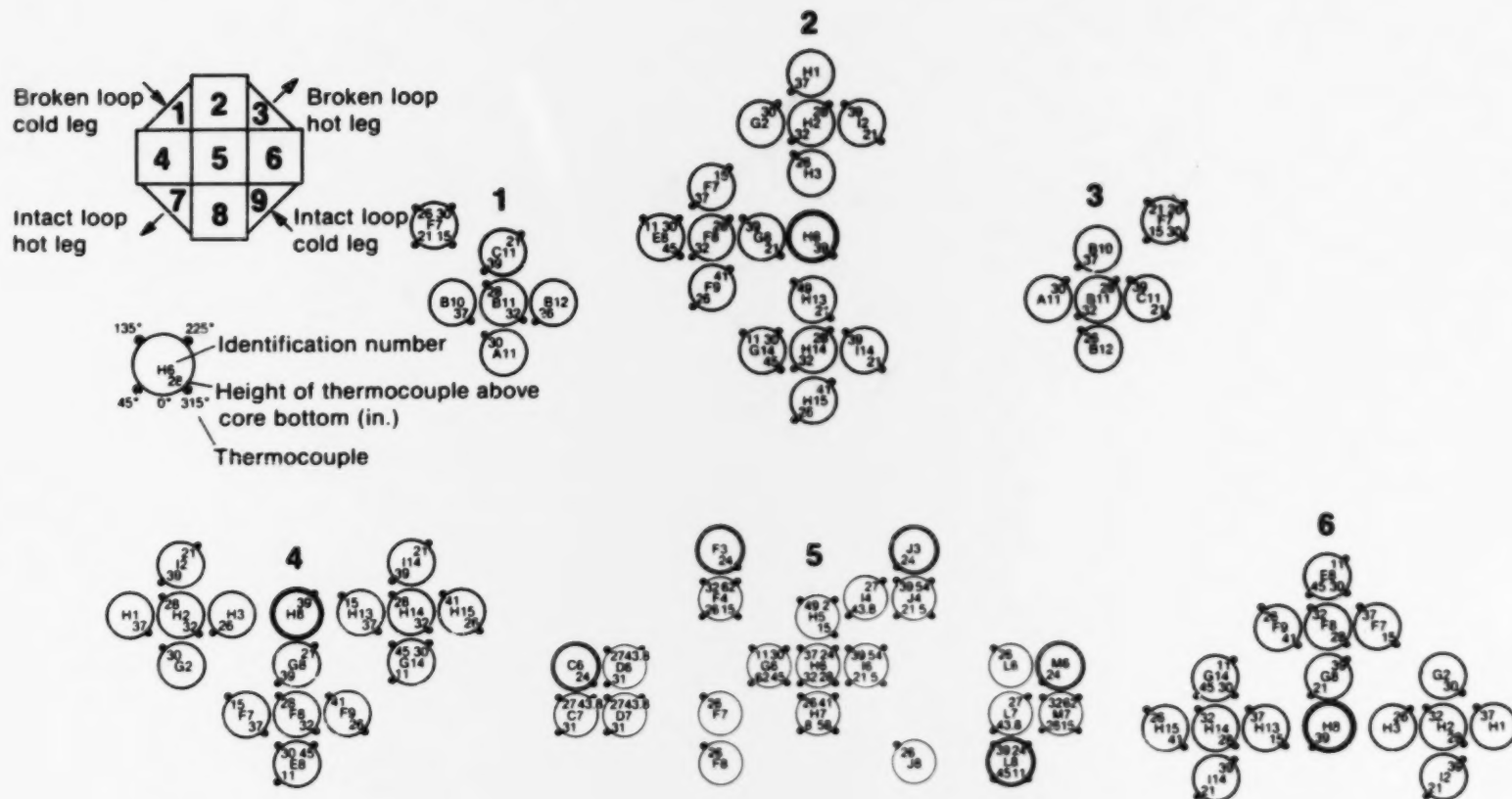
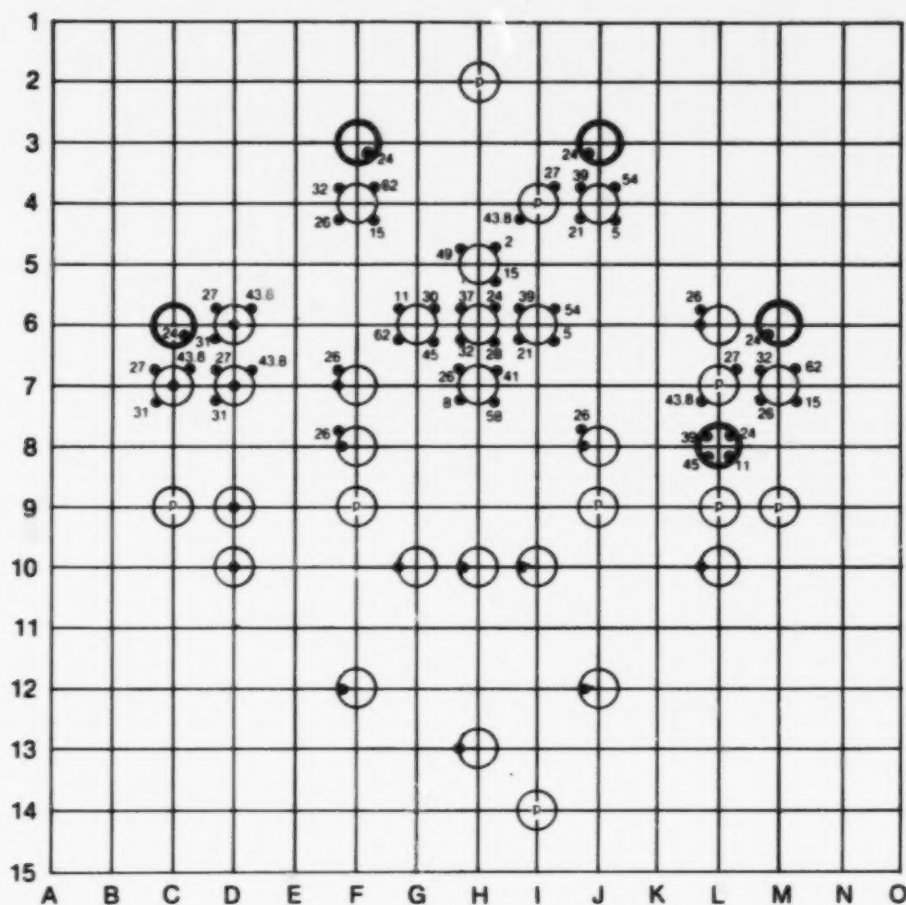


Figure B-9. Cladding surface thermocouple locations for LOFT core.



Thermocouple radial location
and core orientation



- Cladding surface thermocouple
- Cladding embedded thermocouple (26-in. above core bottom)
- Pellet surface thermocouple (26-in. above core bottom)
- Fuel centerline thermocouple (27-in. above core bottom)
- Plenum thermocouple
- Guide tube thermocouple

Numbers indicate height above core bottom (in.)
for cladding surface and guide tube
thermocouples.

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Figure B-10. In-core thermocouple locations for center fuel assembly.

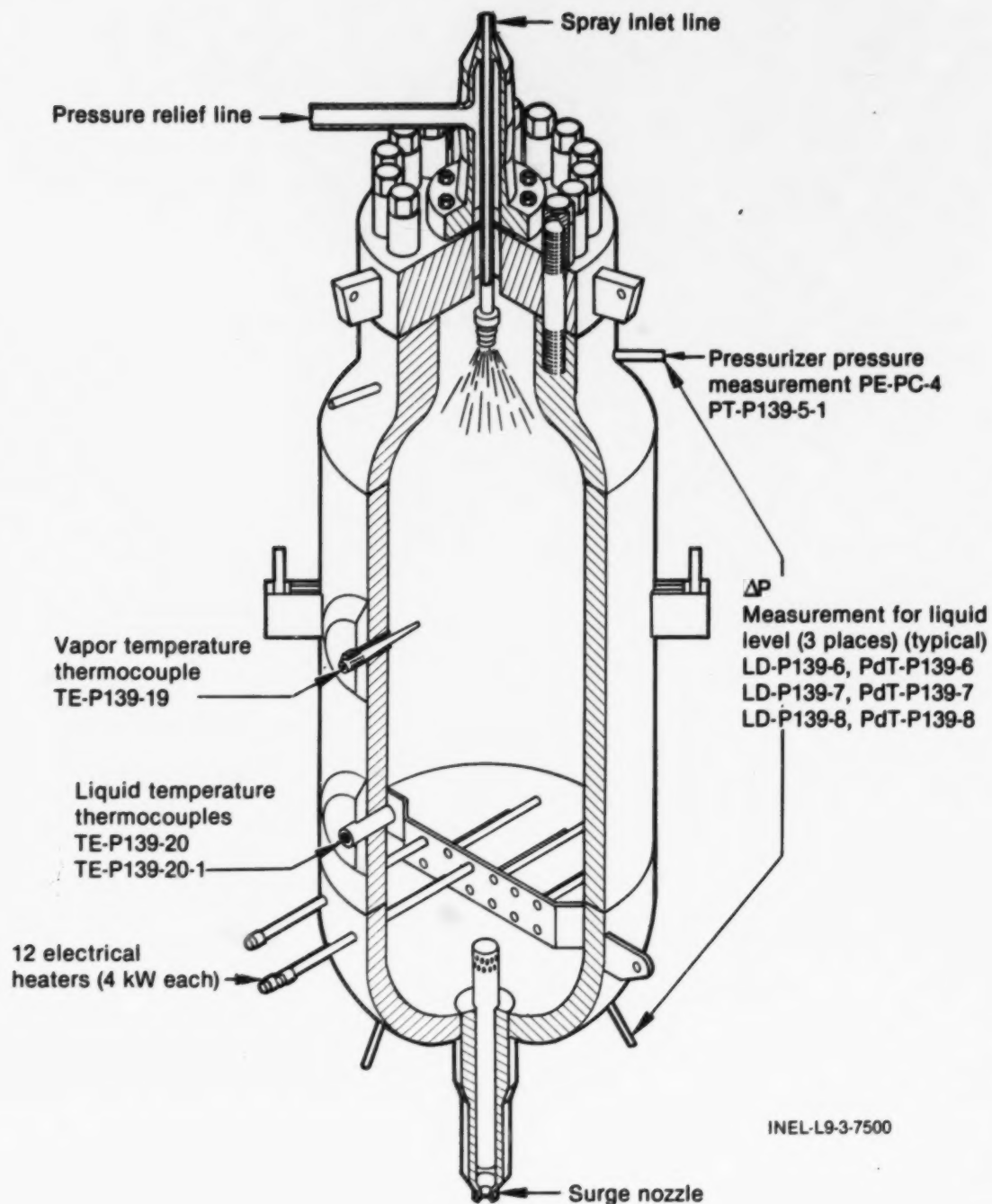
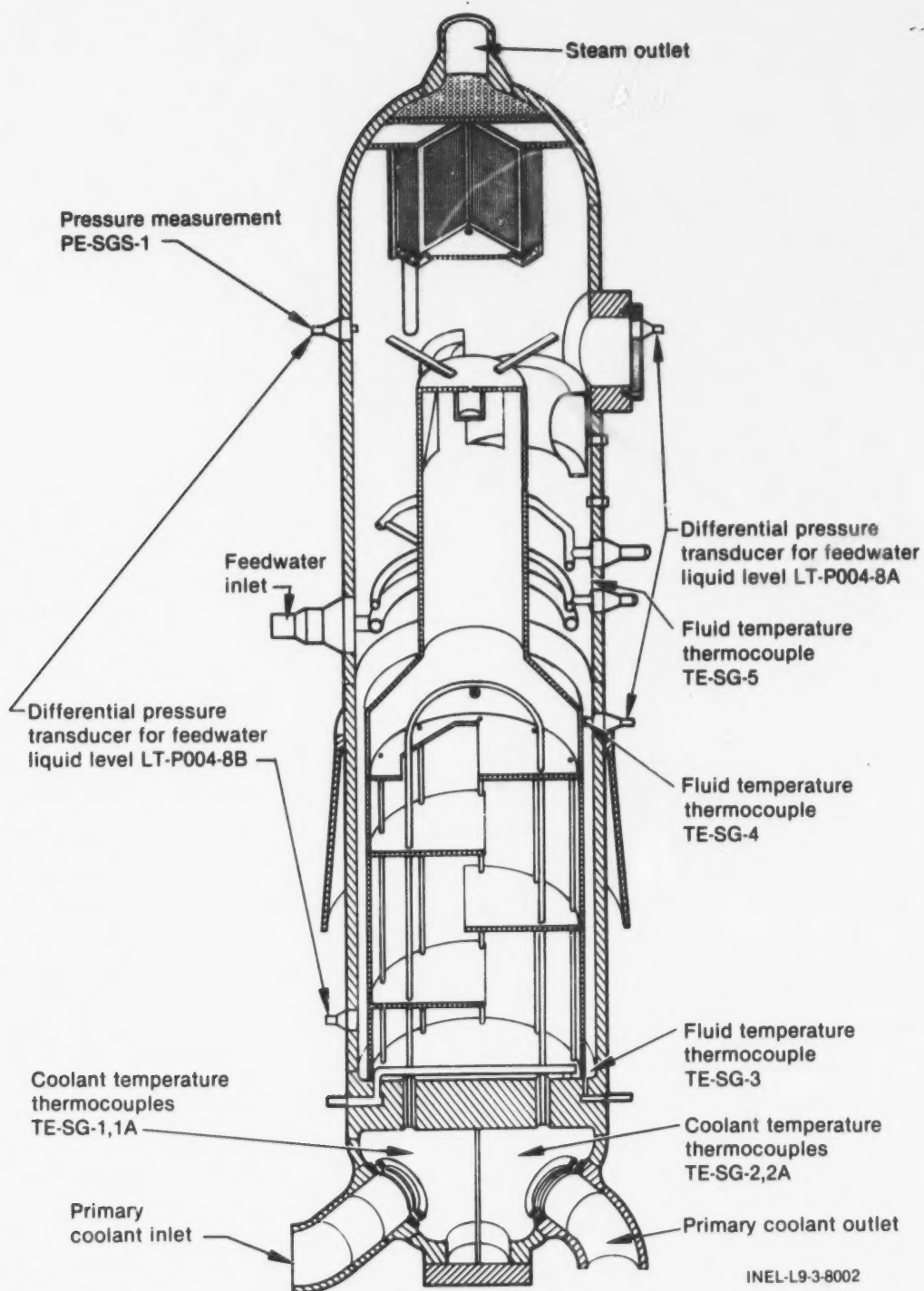


Figure B-11. LOFT pressurizer instrumentation.



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Figure B-12. LOFT steam generator instrumentation.

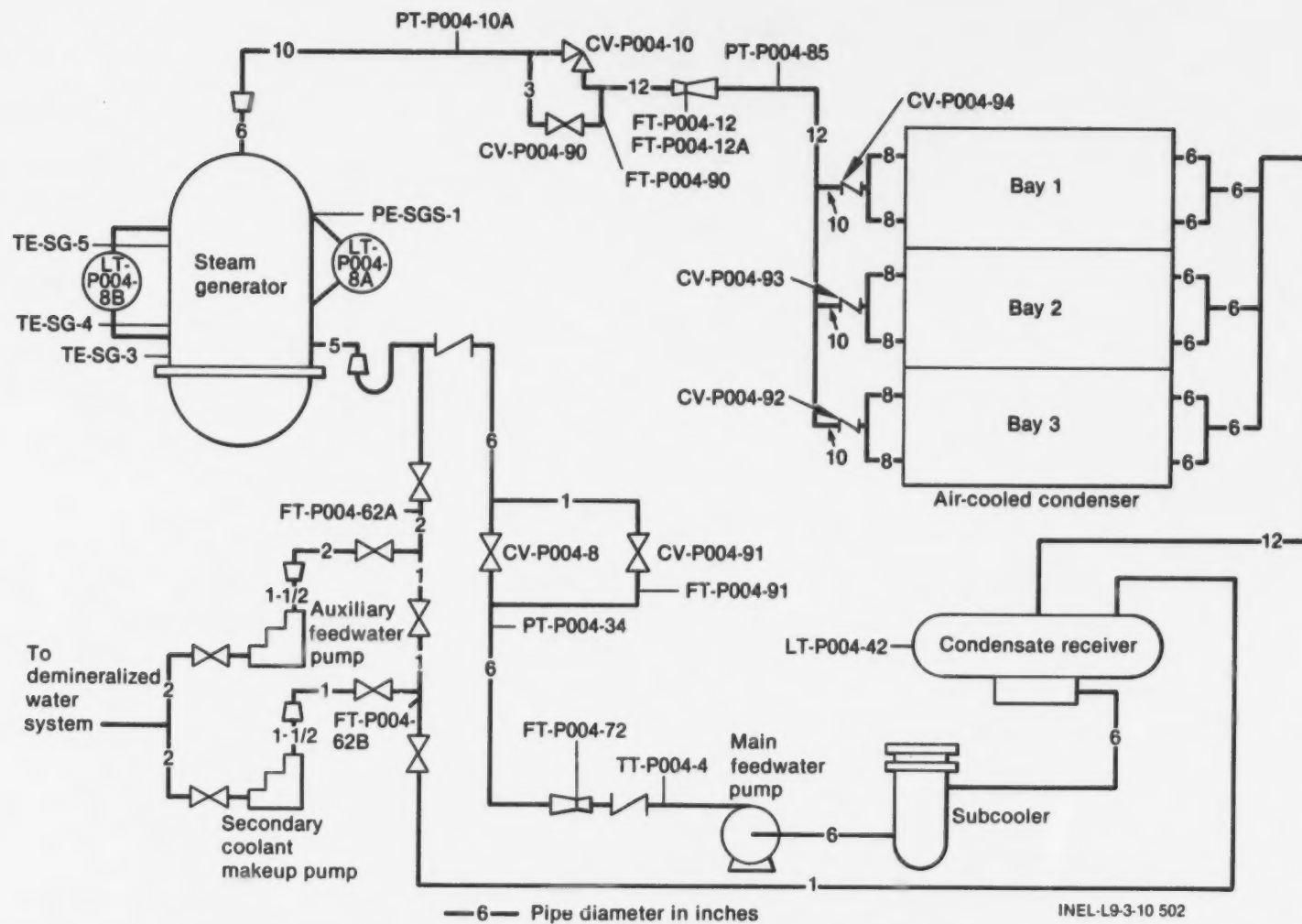


Figure B-13. LOFT secondary coolant system instrumentation.

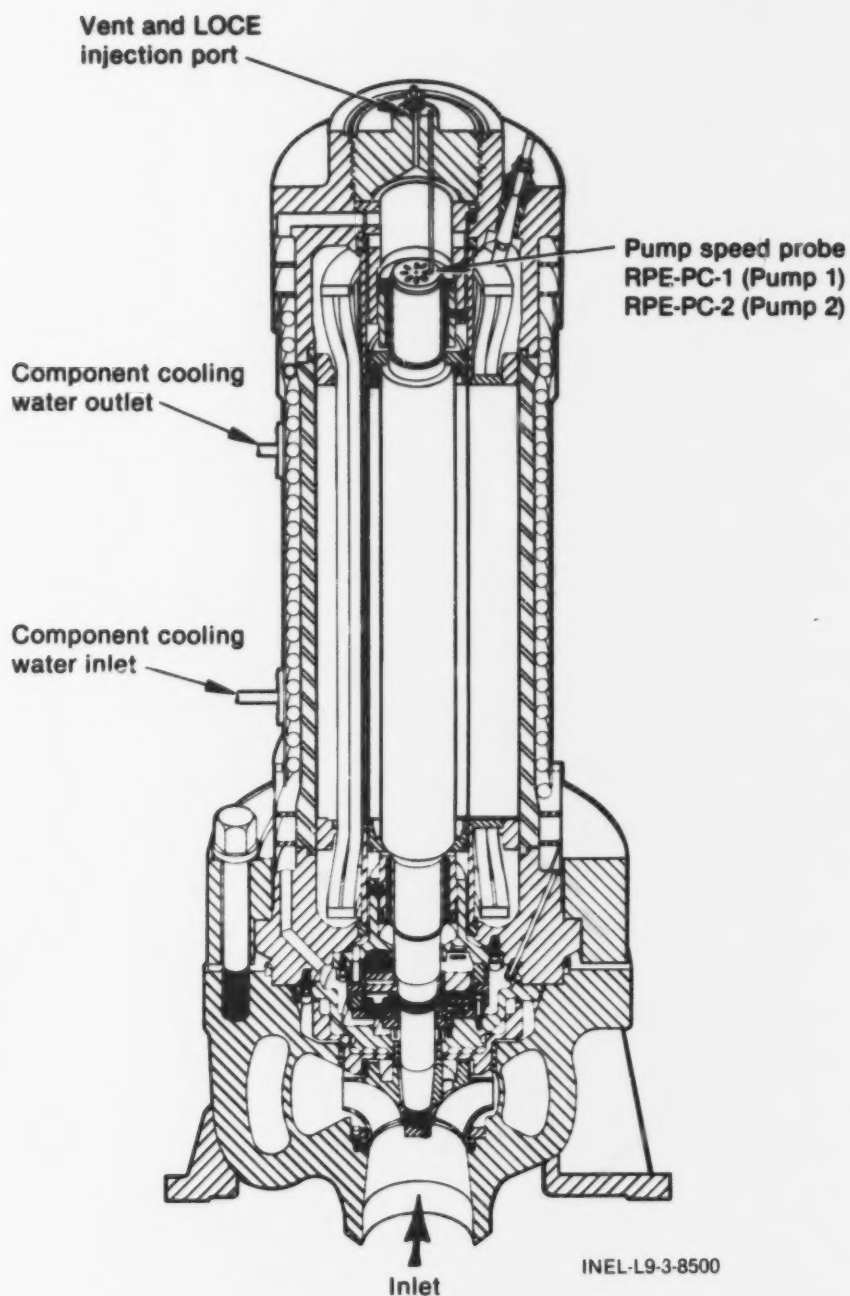


Figure B-14. LOFT primary coolant pump instrumentation.

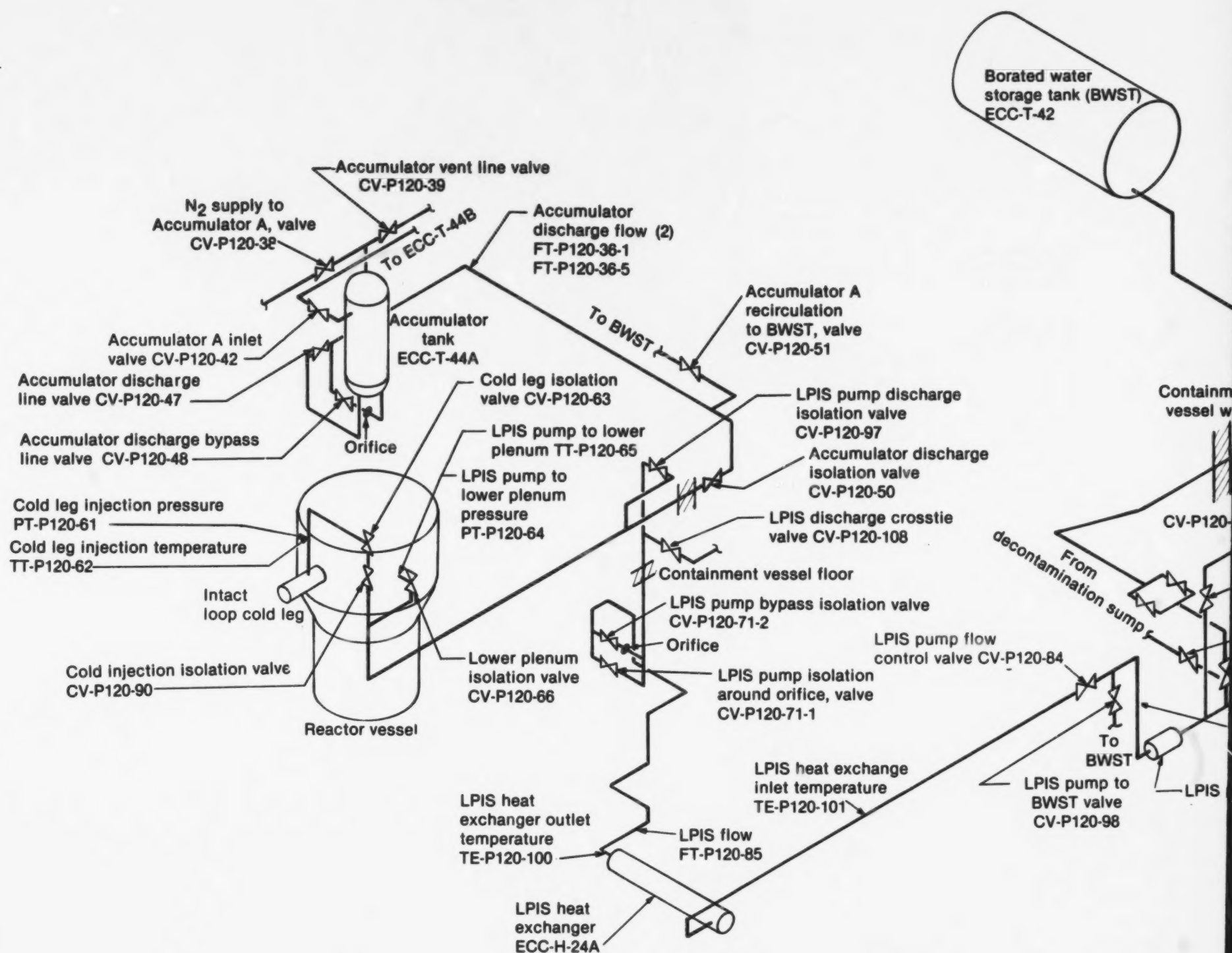


Figure B-15. LOFT ECCS instrumentation—A train.

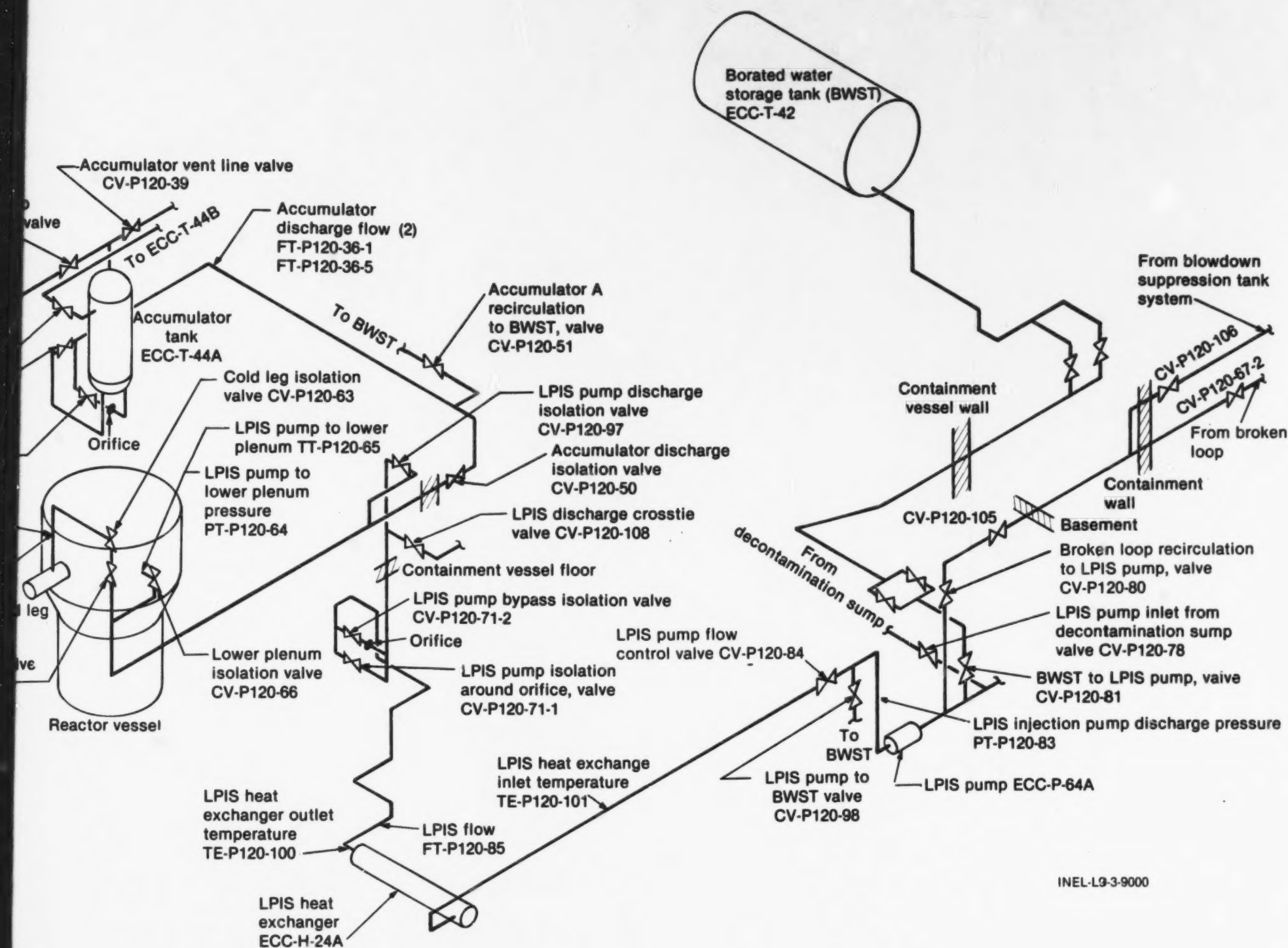
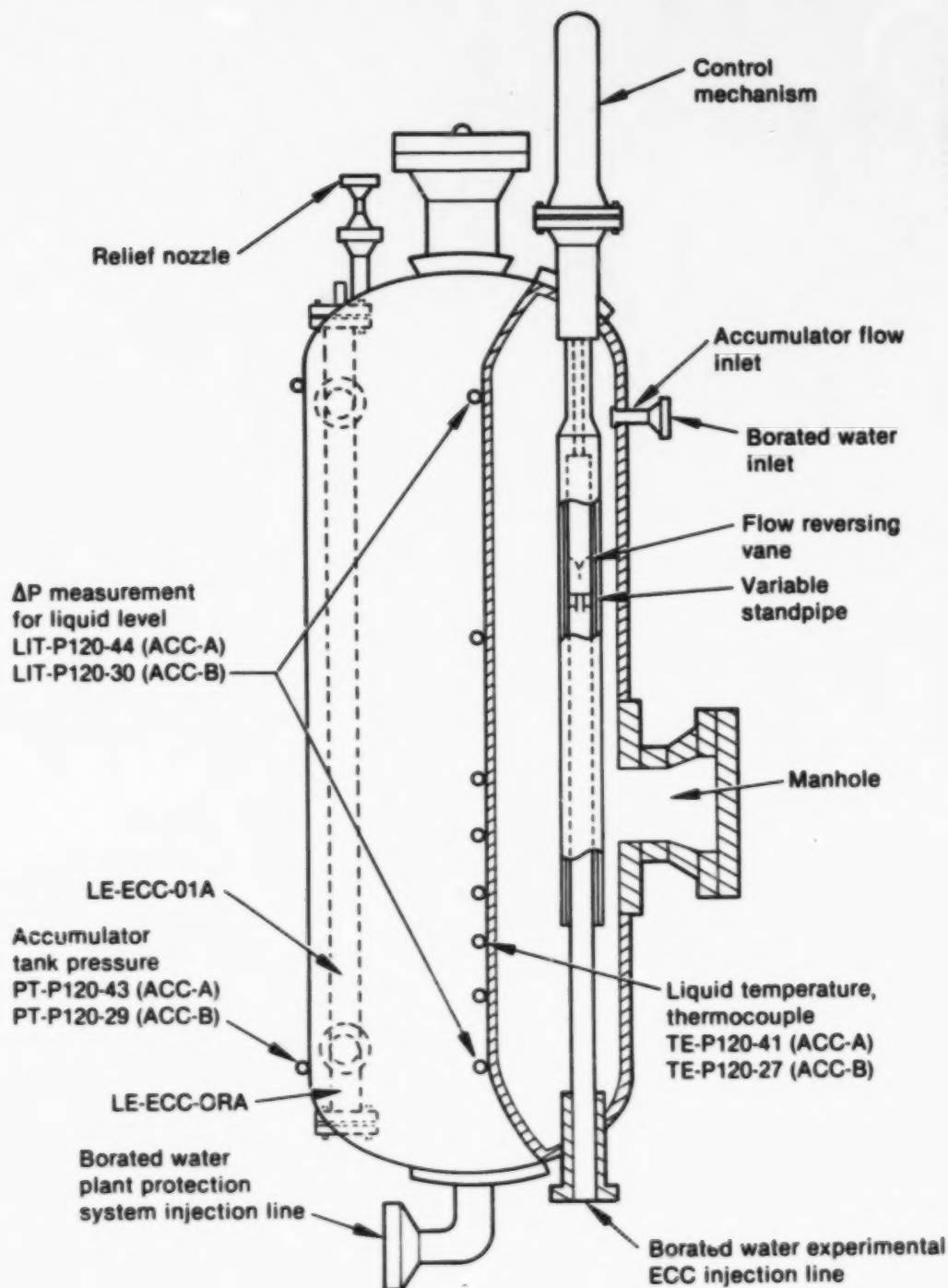


Figure B-15. LOFT ECCS instrumentation—A train.



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Figure B-17. LOFT accumulator instrumentation.

TABLE B-2. EXPERIMENT L9-3 INSTRUMENTATION LIST

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
VALVE OPENING							
<u>Secondary Coolant System</u>							
CV-P004-008	Main feedwater control valve.	0 to 100%	1 Hz	3.5%	0% 25% 50% 100%	3.0% 3.13% 3.47% 4.61%	
CV-P004-010	Main steam control valve.	0 to 100%	1 Hz	3.7%	0% 25% 50% 100%	3.0% 3.13% 3.47% 4.61%	Qualified, no other measurement to verify magnitude.
CV-P004-090	Main steam bypass valve.	0 to 100%	1 Hz	3.0%	0% 25% 50% 100%	3.0% 3.13% 3.47% 4.61%	Qualified, no other measurement to verify magnitude.
CV-P004-091	Main feedwater bypass valve.	0 to 100%	1 Hz	3.0%	0% 25% 50% 100%	3.0% 3.13% 3.47% 4.61%	
<u>Broken Loop</u>							
CV-P138-001	Quick-opening blowdown valve (QORV) in cold leg.	0 to 100%	1 Hz	3.0%	0% 25% 50% 100%	3.0% 3.13% 3.47% 4.61%	
CV-P138-015	QORV in hot leg.	0 to 100%	1 Hz	3.0%	0% 25% 50% 100%	3.0% 3.13% 3.47% 4.61%	
CV-P138-070A	Blowdown system bypass valve.	0 to 100%	1 Hz	4.6%	0% 25% 50% 100%	3.0% 3.13% 3.47% 4.61%	
CV-P138-071A	Blowdown system bypass valve.	0 to 100%	1 Hz	4.6%	0% 25% 50% 100%	3.0% 3.13% 3.47% 4.61%	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
VALVE OPENING (continued)							
<u>Blowdown Suppression System</u>							
CV-P138-123	1.3-L/s spray header control valve.	0 to 100%	1 Hz	4.6%	0% 25% 50% 100%	3.0% 3.13% 3.47% 4.61%	
CV-P138-124	3.8-L/s spray header control valve.	0 to 100%	1 Hz	3.0%	0% 25% 50% 100%	3.0% 3.13% 3.47% 4.61%	
CV-P138-125	13.9-L/s spray header control valve.	0 to 100%	1 Hz	4.6%	0% 25% 50% 100%	3.0% 3.13% 3.47% 4.61%	
<u>Intact Loop</u>							
CV-P139-05-1	Pressurizer spray valve.	0 to 100%	1 Hz	3.0%	0% 25% 50% 100%	3.0% 3.13% 3.47% 4.61%	Qualified.
DENSITY							
<u>Broken Loop</u>							
DE-BL-001A	Broken-loop cold leg at drag disc-turbine trans- ducer (DTT) flange. Beam A is 14° 21 min from Beam B [clockwise (CW) looking toward reactor vessel (RV)].	0 to 1.0 Mg/m ³	1 Hz	0.11 Mg/m ³	--	0.11 Mg/m ³ b,c	
PF-BL-001B	Broken-loop cold leg at DTT flange. Beam B through centerline of pipe 45° from vertical [counterclockwise (CCW) looking toward RV].	0 to 1.0 Mg/m ³	1 Hz	0.099 Mg/m ³	--	0.099 Mg/m ³	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
DENSITY (continued)							
<u>Broken Loop (continued)</u>							
DE-BL-001C	Broken-loop cold leg at DTT flange. Beam C is 22° 7 min from Beam B (CCW looking toward RV).	0 to 1.0 Mg/m ³	1 Hz	0.18 Mg/m ³	--	0.18 Mg/m ³	
DE-BL-002A	Broken-loop hot leg at DTT flange. Beam A is 14° 21 min from Beam B (CCW looking toward RV).	0 to 1.0 Mg/m ³	1 Hz	0.11 Mg/m ³	--	0.11 Mg/m ³	
DE-BL-002B	Broken-loop hot leg at DTT flange. Beam B through centerline of pipe 45° from vertical (CW looking toward RV).	0 to 1.0 Mg/m ³	1 Hz	0.099 Mg/m ³	--	0.099 Mg/m ³	
DE-BL-002C	Broken-loop hot leg at DTT flange. Beam C is 22° 7 min from Beam B (CW looking toward RV).	0 to 1.0 Mg/m ³	1 Hz	0.18 Mg/m ³	--	0.18 Mg/m ³	
DE-PC-S03A	Pressure relief line upstream from experiment relief valve.	0 to 1.0 Mg/m ³	1 Hz	0.10 Mg/m ³	--	0.10 Mg/m ³	Qualified.
DE-PC-S03B	Pressure relief line upstream from experiment relief valve.	0 to 1.0 Mg/m ³	1 Hz	--	--	0.10 Mg/m ³	Failed.
DE-PC-001A	Intact-loop cold leg at DTT flange. Beam A is 14° 21 min from Beam B (CW looking away from RV).	0 to 1.0 Mg/m ³	1 Hz	0.11 Mg/m ³	--	0.11 Mg/m ³	
DE-PC-001B	Intact-loop cold leg at DTT flange. Beam B through centerline of pipe 45° from vertical (CCW looking away from RV).	0 to 1.0 Mg/m ³	1 Hz	0.13 Mg/m ³	--	0.13 Mg/m ³	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
DENSITY (continued)							
<u>Intact Loop</u>							
DE-PC-001C	Intact-loop cold leg at DTT flange. Beam C is 22° 7 min from Beam B (CCW looking away from RV).	0 to 1.0 Mg/m ³	1 Hz	0.18 Mg/m ³	--	0.18 Mg/m ³	
DE-PC-002A	Intact-loop hot leg at DTT flange. Beam A is 14° 21 min from Beam B (CW looking away from RV).	0 to 1.0 Mg/m ³	1 Hz	0.13 Mg/m ³	--	0.13 Mg/m ³	
DE-PC-002B	Intact-loop hot leg at DTT flange. Beam B through centerline of pipe 45° from vertical (CCW looking away from RV).	0 to 1.0 Mg/m ³	1 Hz	0.13 Mg/m ³	--	0.13 Mg/m ³	
DE-PC-002C	Intact-loop hot leg at DTT flange. Beam C is 22° 7 min from Beam B (CCW looking away from RV).	0 to 1.0 Mg/m ³	1 Hz	0.18 Mg/m ³	--	0.18 Mg/m ³	
DE-PC-003B	Intact loop below SG at DTT flange. Beam B is through centerline of pipe 45° from vertical.	0 to 1.0 Mg/m ³	1 Hz	0.13 Mg/m ³	--	0.13 Mg/m ³	
FUEL ASSEMBLY DISPLACEMENT							
<u>Assembly 5</u>							
DIE-5G13-001	Fuel rod at Row G, Column 13 of Fuel Assembly 5.	±10 mm	1 Hz	0.3 mm	0 mm 5 mm 10 mm	0.3 mm ^d 0.32 mm 0.36 mm	
DIE-5H03-001	Fuel rod at Row H, Column 3 of Fuel Assembly 5.	±10 mm	1 Hz	0.3 mm	0 mm 5 mm 10 mm	0.3 mm 0.32 mm 0.36 mm	

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TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
FUEL ASSEMBLY DISPLACEMENT (continued)							
<u>Assembly 5</u> (continued)							
DIF-5I13-001	Fuel rod at Row I, Column 13 of Fuel Assembly 5.	±10 mm	1 Hz	0.3 mm	0 mm 5 mm 10 mm	0.3 mm 0.32 mm 0.36 mm	
DIF-5UP-001	At top center of Fuel Assembly 5.	±12.7 mm	1 Hz	0.3 mm	0 mm 6.35 mm 12.7 mm	0.3 mm 0.33 mm 0.39 mm	
DIF-5UP-002	At top center of Fuel Assembly 5.	±12.7 mm	1 Hz	0.3 mm	0 mm 6.35 mm 12.7 mm	0.3 mm 0.33 mm 0.39 mm	
FLUID VELOCITY							
<u>Intact Loop</u>							
FE-PC-S02	Pressure relief line upstream from experiment relief valve.	0.5 to 23 m/s	1 Hz	0.2 m/s	2 m/s 10 m/s 20 m/s 40 m/s	0.28 m/s ^e 0.60 m/s 1.0 m/s 1.8 m/s	Qualified.
FE-PC-001A	Cold leg DTT horizontal flange on west side of pipe.	0.4 to 10.6 m/s	1 Hz	0.42 m/s	1 m/s 5 m/s 10 m/s	0.20 m/s 0.30 m/s 1.40 m/s	Qualified.
FE-PC-001B	Cold leg DTT horizontal flange at center of pipe.	0.4 to 10.6 m/s	1 Hz	0.42 m/s	1 m/s 5 m/s 10 m/s	0.20 m/s 0.30 m/s 0.40 m/s	Qualified.
FE-PC-001C	Cold leg DTT horizontal flange on east side of pipe.	0.4 to 10.6 m/s	1 Hz	0.42 m/s	1 m/s 5 m/s 10 m/s	0.20 m/s 0.30 m/s 0.40 m/s	Qualified.
FE-PC-002A	Hot leg DTT flange at bottom of pipe.	0.6 to 15.2 m/s	1 Hz	0.42 m/s	1 m/s 8 m/s 15 m/s	0.22 m/s 0.36 m/s 0.50 m/s	Qualified.
FE-PC-002B	Hot leg DTT flange at middle of pipe.	0.6 to 15.2 m/s	1 Hz	0.42 m/s	1 m/s 8 m/s 15 m/s	0.22 m/s 0.36 m/s 0.50 m/s	Qualified.

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
FLUID VELOCITY (continued)							
<u>Intact Loop (continued)</u>							
FF-PC-002C	Hot leg DTT flange at top of pipe.	0.6 to 15.2 m/s	1 Hz	0.42 m/s	1 m/s 8 m/s 15 m/s	0.22 m/s 0.36 m/s 0.50 m/s	Qualified.
<u>Reactor Vessel</u>							
FE-1ST-001	Downcomer Stalk 1.	0.4 to 10.6 m/s	1 Hz	0.39 m/s	1 m/s 5 m/s 10 m/s	0.23 m/s 0.35 m/s 0.50 m/s	Qualified, normalized to indicate average flow in downcomer.
FE-1ST-002	Downcomer Stalk 1.	0.4 to 10.6 m/s	1 Hz	0.39 m/s	1 m/s 5 m/s 10 m/s	0.23 m/s 0.35 m/s 0.50 m/s	Qualified, normalized to indicate average flow in downcomer.
FF-5LP-001	Lower end box of Fuel Assembly 5.	0.4 to 10.6 m/s	1 Hz	0.39 m/s	1 m/s 5 m/s 10 m/s	0.23 m/s 0.35 m/s 0.50 m/s	Qualified, normalized to indicate average flow in the lower plenum.
FF-5LP-002	Lower end box of Fuel Assembly 5.	0.4 to 10.6 m/s	1 Hz	0.39 m/s	1 m/s 5 m/s 10 m/s	0.23 m/s 0.35 m/s 0.50 m/s	Qualified, normalized to indicate average flow in the lower plenum.
FF-5UP-001	Above upper end box of Fuel Assembly 5.	0.4 to 10.6 m/s	1 Hz	0.37 m/s	1 m/s 5 m/s 10 m/s	0.23 m/s 0.35 m/s 0.50 m/s	Qualified, normalized to indicate average flow in the upper plenum.
FLOW RATE							
<u>Blowdown Sup- pression Tank Spray System</u>							
FE-P138-138	Blowdown suppression tank (BST) spray flow rate in the 3.79-L/s header.	0 to 6 l/s	1 Hz	0.17 l/s	--	0.17 l/s	
FE-P138-139	BST spray flow rate from pump discharge.	0 to 25 l/s	1 Hz	0.33 l/s	--	0.33 l/s	
FE-P138-140	BST spray flow rate in 13.9-l/s header.	0 to 20 l/s	1 Hz	0.25 l/s	--	0.25 l/s	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
FLOW RATE (continued)							
<u>Blowdown Sup- pression Tank Spray System (continued)</u>							
FE-P138-153	BST spray flow rate in spray pump recirculation line.	0 to 10 L/s	1 Hz	0.33 L/s	--	0.33 L/s	
<u>Secondary Coolant System</u>							
FT-P004-012	Inlet to air-cooled condenser inlet header.	0 to 40 kg/s	1 Hz	1.1 kg/s	--	1.1 kg/s	Qualified, forced to agree with reactor power at initial conditions.
FT-P004-012A	Inlet to air-cooled condenser inlet header.	0 to 4 kg/s	1 Hz	0.20 kg/s	--	0.20 kg/s	Qualified, forced to agree with reactor power at initial conditions.
FT-P004-062A	Auxiliary feedwater and makeup pumps discharge flow to steam generator.	0 to 1.3 l/s	1 Hz	0.065 L/s	--	0.065 L/s	Qualified to 1080 s, failed thereafter.
FT-P004-062B	Makeup pump discharge flow.	0 to 1.3 l/s	1 Hz	0.065 L/s	--	0.065 L/s	
FT-P004-72A	Main feedwater pump discharge flow.	0 to 25 kPa	100 Hz	1.5 kPa	5 kPa 15 kPa 25 kPa	0.3 kPa 0.9 kPa 1.5 kPa	
FT-P004-72-2	Flow out of main feed- water pump.	0 to 40 kg/s	1 Hz	1.1 kg/s	--	1.1 kg/s	Qualified, forced to agree with reactor power at initial conditions.
FT-P004-090	Steam flow control valve bypass line.	0 to 4 kg/s	1 Hz	0.082 kg/s	--	0.082 kg/s	Qualified, no other measurement to verify magnitude, possible zero offset drift.
FT-P004-091	Main feedwater control valve bypass line.	0 to 5 l/s	1 Hz	0.075 l/s	--	0.075 l/s	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
FLOW RATE (continued)							
<u>Emergency Core Cooling System</u>							
FT-P120-31-1	Accumulator B in 6-in. line downstream from orifice.	0 to 40 L/s	1 Hz	0.28 L/s	--	0.28 L/s	
FT-P120-31-5	Accumulator B in 6-in. line downstream from orifice.	0 to 125 L/s	1 Hz	0.92 L/s	--	0.92 L/s	
FT-P120-36-1	Accumulator A in 6-in. line downstream from orifice.	0 to 125 L/s	1 Hz	0.92 L/s	--	0.92 L/s	
FT-P120-36-5	Accumulator A in 6-in. line downstream from orifice.	0 to 40 L/s	1 Hz	0.28 L/s	--	0.28 L/s	
FT-P120-085	Low-pressure injection system (LPIS) Pump A discharge.	0 to 25 L/s	1 Hz	0.37 L/s	--	0.37 L/s	
FT-P128-085	High-pressure injection system (HPIS) Pump B discharge.	0 to 2 L/s	1 Hz	0.014 L/s	--	0.014 L/s	Qualified, r other measurement for direct comparison.
FT-P128-104	HPIS Pump A discharge.	0 to 2 L/s	1 Hz	0.014 L/s	--	0.014 L/s	
<u>Intact Loop</u>							
FT-P139-27-1	Intact-loop hot leg venturi flowmeter (right side facing SG).	0 to 630 kg/s	1 Hz	4.6 kg/s	--	4.6 kg/s	Qualified, anomalous spikes between 900 and 1400 s.
FT-P139-27-2	Intact-loop hot leg venturi flowmeter (bottom of pipe).	0 to 630 kg/s	1 Hz	4.6 kg/s	--	4.6 kg/s	Qualified.
FT-P139-27-3	Intact-loop hot leg venturi flowmeter (left side facing SG).	0 to 630 kg/s	1 Hz	4.6 kg/s	--	4.6 kg/s	Qualified.

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
FLOW RATE (continued)							
<u>Primary Com- ponent Cooling System</u>							
FT-P141-022	Primary component cooling system.	0 to 22 L/s	1 Hz	0.16 L/s	--	0.16 L/s	
LIQUID LEVEL							
<u>Intact Loop</u>							
LD-P139-006	Pressurizer liquid level on southeast side.	0 to 1.8 m	1 Hz	--	--	0.06 m	Failed.
LD-P139-007	Pressurizer liquid level on southwest side.	0 to 1.8 m	1 Hz	--	--	0.06 m	Failed.
LD-P139-008	Pressurizer liquid level on north side.	0 to 1.8 m	1 Hz	--	--	0.06 m	Failed.
<u>Emergency Core Cooling System</u>							
IF-ECC-01A	Accumulator A.	0 to 3.0 m	1 Hz	0.007 m	--	0.007 m	
LIT-P120-030	Accumulator B.	0 to 3.0 m	1 Hz	0.02 m	--	0.02 m	
LIT-P120-044	Accumulator A.	0 to 3.0 m	1 Hz	0.02 m	--	0.02 m	
LIT-P120-087	Accumulator A.	0 to 3.0 m	10 Hz	0.02 m	--	0.02 m	
LIT-P120-089	Accumulator B.	0 to 3.0 m	10 Hz	0.02 m	--	0.02 m	
<u>Secondary Coolant System</u>							
LT-P004-008A	SG (narrow range).	-1.0 to 1.5 m ^f	1 Hz	0.127 m	--	0.127 m	Qualified, narrow range instrument.
LT-P004-008B	SG (wide range).	-3.7 to 1.5 m	1 Hz	0.127 m	--	0.127 m	Qualified.
LT-P004-08AA	SG (narrow range).	-1.0 to 1.5 m	1 Hz	0.127 m	--	0.127 m	Qualified, narrow range instrument.
LT-P004-08BB	SG (wide range).	-3.7 to 1.5 m	1 Hz	0.127 m	--	0.127 m	Qualified.

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
LIQUID LEVEL (continued)							
<u>Secondary Coolant System (continued)</u>							
LT-P004-042	Condensate receiver, 1.83 m south of condensate receiver centerline.	0 to 1.2 m	1 Hz	0.01 m	--	0.01 m	Qualified, absolute magnitude uncertain.
<u>Blowdown Sup- pression Tank</u>							
LT-P138-033	BST level on north end of tank.	0 to 3.5 m	1 Hz	--	--	0.025 m	Failed.
LT-P138-058	BST level on south end of tank.	0 to 3.5 m	1 Hz	0.026 m	--	0.026 m	Qualified.
MOMENTUM FLUX							
<u>Intact Loop</u>							
MF-PC-S02	Pressure relief line upstream from experiment relief valve.	3.0 to 74.4 Mg/m ²	1 Hz	2.0 Mg/m ²	3 Mg/m ² 10 Mg/m ² 40 Mg/m ² 75 Mg/m ²	2.2 Mg/m ² 2.6 Mg/m ² 4.4 Mg/m ² 6.5 Mg/m ²	Qualified, shows negative momentum due to unresolvable temperature compensation.
MF-PC-001A	Cold leg DTT horizontal flange on west side of pipe.	1.2 to 20.8 Mg/m ²	1 Hz	3.3 Mg/m ²	--	3.3 Mg/m ²	
MF-PC-001B	Cold leg DTT horizontal flange at center of pipe.	1.2 to 20.8 Mg/m ²	1 Hz	3.3 Mg/m ²	--	3.3 Mg/m ²	
MF-PC-001C	Cold leg DTT horizontal flange on east side of pipe.	1.2 to 20.8 Mg/m ²	1 Hz	3.3 Mg/m ²	--	3.3 Mg/m ²	
MF-PC-002A	Hot leg DTT flange at bottom of pipe.	1.2 to 20.8 Mg/m ²	1 Hz	3.3 Mg/m ²	--	3.3 Mg/m ²	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
MOMENTUM FLUX (continued)							
<u>Intact Loop</u> (continued)							
ME-PC-002B	Hot leg DTT flange at middle of pipe.	1.2 to 20.8 Mg/m ²	1 Hz	3.3 Mg/m ²	--	3.3 Mg/m ²	
ME-PC-002C	Hot leg DTT flange at top of pipe.	1.2 to 20.8 Mg/m ²	1 Hz	3.3 Mg/m ²	--	3.3 Mg/m ²	
<u>Reactor Vessel</u>							
MF-1ST-001	Downcomer Stalk 1, 1.16 m above RV bottom.	0.3 to 52.1 Mg/m ²	1 Hz	8.3 Mg/m ²	--	8.3 Mg/m ²	
MF-1ST-002	Downcomer Stalk 1, 1.16 m above RV bottom.	0.3 to 52.1 Mg/m ²	1 Hz	8.3 Mg/m ²	--	8.3 Mg/m ²	
ME-3UP-001	Fuel Assembly 3 above upper end box.	0.3 to 12 Mg/m ²	1 Hz	--	--	0.78 Mg/m ²	Failed.
ME-5LP-001	Fuel Assembly 5 lower end box.	1.2 to 20.8 Mg/m ²	1 Hz	3.3 Mg/m ²	--	3.3 Mg/m ²	
MF-5LP-002	Fuel Assembly 5 lower end box.	1.2 to 20.8 Mg/m ²	1 Hz	3.3 Mg/m ²	--	3.3 Mg/m ²	
MF-5UP-001	Fuel Assembly 5 above upper end box.	1.2 to 20.8 Mg/m ²	1 Hz	3.3 Mg/m ²	--	3.3 Mg/m ²	
NEUTRON DETECTION							
<u>Reactor Vessel</u>							
MF-2H08-26	Neutron detector in Fuel Assembly 2.	0 to 52.5 kW/m (local)	1 Hz	2.6 kW/m	5 kW/m 25 kW/m 52.5 kW/m	0.48 kW/m 2.4 kW/m 5.0 kW/m	Qualified.
MF-4H08-26	Neutron detector in Fuel Assembly 4.	0 to 52.5 kW/m (local)	1 Hz	--	5 kW/m 25 kW/m 52.5 kW/m	0.48 kW/m 2.4 kW/m 5.0 kW/m	Failed.
MF-5H08-11	Neutron detector in Fuel Assembly 5.	0 to 52.5 kW/m (local)	1 Hz	--	5 kW/m 25 kW/m 52.5 kW/m	0.48 kW/m 2.4 kW/m 5.0 kW/m	Failed.

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
NEUTRON DETECTION (continued)							
<u>Reactor Vessel (continued)</u>							
NE-5D08-27	Neutron detector in Fuel Assembly 5.	0 to 52.5 kW/m (local)	1 Hz	--	5 kW/m 25 kW/m 52.5 kW/m	0.48 kW/m 2.4 kW/m 5.0 kW/m	Failed.
NE-5D08-44	Neutron detector in Fuel Assembly 5.	0 to 52.5 kW/m (local)	1 Hz	--	5 kW/m 25 kW/m 52.5 kW/m	0.48 kW/m 2.4 kW/m 5.0 kW/m	Failed.
NE-5D08-61	Neutron detector in Fuel Assembly 5.	0 to 52.5 kW/m (local)	1 Hz	3.8 kW/m	5 kW/m 25 kW/m 52.5 kW/m	0.48 kW/m 2.4 kW/m 5.0 kW/m	Qualified, no other measurement for direct comparison.
NE-6H08-26	Neutron detector in Fuel Assembly 6.	0 to 52.5 kW/m (local)	1 Hz	2.9 kW/m	5 kW/m 25 kW/m 52.5 kW/m	0.48 kW/m 2.4 kW/m 5.0 kW/m	Qualified.
ELECTRICAL FREQUENCY							
<u>Intact Loop</u>							
PCP-1-F	Primary coolant pump (PCP) 1.	0 to 75 Hz	1 Hz	0.75 Hz	--	0.75 Hz ^h	Qualified.
PCP-2-F	PCP-2.	0 to 75 Hz	1 Hz	0.75 Hz	--	0.75 Hz	Qualified.
ELECTRICAL CURRENT							
<u>Intact Loop</u>							
PCP-1-I-RMS	PCP-1.	0 to 1000 amp RMS	1 Hz	23 amp	100 amp 300 amp 600 amp	5 amp 15 amp 30 amp	Qualified.
PCP-2-I-RMS	PCP-2.	0 to 1000 amp RMS	1 Hz	23 amp	100 amp 300 amp 600 amp	5 amp 15 amp 30 amp	Qualified.

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
ELECTRICAL POWER							
<u>Intact Loop</u>							
PCP-1-P	PCP-1.	0 to 1 MW	1 Hz	0.05 MW	--	0.05 MW	
PCP-2-P	PCP-2.	0 to 1 MW	1 Hz	0.05 MW	--	0.05 MW	
REACTIVE POWER							
<u>Intact Loop</u>							
PCP-1-P-VAR	PCP-1.	0 to 1000 kVAR	1 Hz	50 kVAR	--	50 kVAR	
PCP-2-P-VAR	PCP-2.	0 to 1000 kVAR	1 Hz	50 kVAR	--	50 kVAR	
ELECTRICAL VOLTAGE							
<u>Intact Loop</u>							
PCP-1-V-RMS	PCP-1.	0 to 600 V RMS	1 Hz	--	100 V 300 V 600 V	5 V 15 V 30 V	Failed.
PCP-2-V-RMS	PCP-2.	0 to 600 V RMS	1 Hz	--	100 V 300 V 600 V	5 V 15 V 30 V	Failed.
DIFFERENTIAL PRESSURE							
<u>Intact Loop</u>							
PdF-PC-S02	Pressure relief line across DTT spool piece.	±175 kPa	1 Hz	1.9 kPa	0 kPa 100 kPa 175 kPa	1.9 kPa ⁱ 4.4 kPa 7.3 kPa	
PdE-PC-S03	Pressure relief line across experiment relief valve.	±10 MPa	1 Hz	--	0 MPa 5 MPa 10 MPa	0.05 MPa 0.20 MPa 0.39 MPa	Failed.

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
DIFFERENTIAL PRESSURE (continued)							
<u>Intact Loop (continued)</u>							
PdE-PC-001	Intact loop cold leg across PCFs.	±700 kPa	1 Hz	19.2 kPa	0 kPa 350 kPa 700 kPa	7.4 kPa 15.8 kPa 28.9 kPa	Qualified.
PdE-PC-002	Intact loop across SG.	±350 kPa	1 Hz	9.4 kPa	0 kPa 150 kPa 350 kPa	0.84 kPa 6.2 kPa 14.0 kPa	Qualified.
PdE-PC-003	Intact loop hot leg piping, RV to SG inlet.	±175 kPa	1 Hz	3.3 kPa	0 kPa 87 kPa 175 kPa	2.9 kPa 4.5 kPa 7.6 kPa	Qualified.
PdE-PC-005	Intact loop cold leg PCFs to RV nozzle.	±27.4 kPa	1 Hz	1.4 kPa	0 kPa 20 kPa 40 kPa	0.84 kPa 1.2 kPa 1.8 kPa	Qualified, clipped at 27.4 kPa.
PdE-PC-008	Intact loop across pressurizer surge line.	±40 kPa	1 Hz	0.9 kPa	0 kPa 20 kPa 40 kPa	0.84 kPa 1.2 kPa 1.8 kPa	Qualified, pegged approximately 75 to 85 s.
PdE-PC-009	Intact loop across PCF-1.	±700 kPa	1 Hz	24.1 kPa	0 kPa 350 kPa 700 kPa	16 kPa 21 kPa 32 kPa	Qualified.
PdE-PC-010	Intact loop across PCF-2.	±1400 kPa	1 Hz	24.5 kPa	0 kPa 350 kPa 700 kPa	16 kPa 21 kPa 32 kPa	Qualified.
PdE-PC-015	Pitot tube at top of emergency core coolant (ECC) Rake 1 (facing PCF).	±40 kPa	1 Hz	1.2 kPa	0 kPa 20 kPa 40 kPa	0.84 kPa 1.2 kPa 1.8 kPa	
PdE-PC-016	Pitot tube next to top of ECC Rake 1 (facing PCF).	±40 kPa	1 Hz	0.9 kPa	0 kPa 20 kPa 40 kPa	0.84 kPa 1.2 kPa 1.8 kPa	
PdE-PC-017	Pitot tube next to bottom of ECC Rake 1 (facing PCF).	±40 kPa	1 Hz	1.5 kPa	0 kPa 20 kPa 40 kPa	0.84 kPa 1.2 kPa 1.8 kPa	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
DIFFERENTIAL PRESSURE (continued)							
Intact Loop (continued)							
PdE-PC-018	Pitot tube at bottom of ECC Rake 1 (facing PCP).	±40 kPa	1 Hz	1.4 kPa	0 kPa	0.84 kPa	
					20 kPa	1.2 kPa	
					40 kPa	1.8 kPa	
PdE-PC-027	SG outlet to pump suction (lowest point).	±40 kPa	1 Hz	1.8 kPa	0 kPa	0.84 kPa	
					20 kPa	1.2 kPa	
					40 kPa	1.8 kPa	
PdE-PC-028	Pump suction (lowest point) to PCP-2 inlet.	±40 kPa	1 Hz	1.2 kPa	0 kPa	0.84 kPa	
					20 kPa	1.2 kPa	
					40 kPa	1.8 kPa	
Reactor Vessel							
PdE-RV-002	Fuel Assembly 1 from lower end box to upper end box.	±175 kPa	1 Hz	11 kPa	0 kPa	11 kPa	
					100 kPa	12 kPa	
					175 kPa	13 kPa	
PdE-RV-003	Intact-loop cold leg inlet to bottom of downcomer.	±175 kPa	1 Hz	11 kPa	0 kPa	11 kPa	
					100 kPa	12 kPa	
					175 kPa	13 kPa	
PdE-RV-005	Top of RV to intact loop hot leg.	±40 kPa	1 Hz	3.0 kPa	0 kPa	3.0 kPa	
					20 kPa	3.1 kPa	
					40 kPa	3.4 kPa	
Blowdown Sup- pression Tank							
PdE-SV-001	BST.	±25 kPa	1 Hz	0.7 kPa	0 kPa	0.50 kPa	Qualified.
					12 kPa	0.69 kPa	
					25 kPa	1.12 kPa	
PdE-SV-002	BST.	±15 kPa	1 Hz	0.5 kPa	0 kPa	0.19 kPa	Qualified.
					12 kPa	0.53 kPa	
					25 kPa	1.0 kPa	
PdE-SV-009	BST across the vacuum breaker line.	±70 kPa	1 Hz	3.0 kPa	0 kPa	2.9 kPa	
					30 kPa	3.5 kPa	
					70 kPa	5.5 kPa	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
DIFFERENTIAL PRESSURE (continued)							
<u>Pressurizer</u>							
PdT-P139-006	Pressurizer on south- east side.	0.0 to 17.5 kPa	1 Hz	0.05 kPa	5 kPa 10 kPa 17.5 kPa	0.04 kPa 0.07 kPa 0.13 kPa	Qualified.
PdT-P139-007	Pressurizer on south- west side.	0.0 to 17.5 kPa	1 Hz	0.05 kPa	5 kPa 10 kPa 17.5 kPa	0.04 kPa 0.07 kPa 0.13 kPa	Qualified.
PdT-P139-008	Pressurizer on north side.	0.0 to 17.5 kPa	1 Hz	0.05 kPa	5 kPa 10 kPa 17.5 kPa	0.04 kPa 0.07 kPa 0.13 kPa	Qualified.
<u>Intact Loop</u>							
PdT-P139-27-1	Intact-loop venturi, Channel A.	0 to 200 kPa	1 Hz	2 kPa	--	2 kPa	Qualified.
PdT-P139-27-2	Intact-loop venturi, Channel B.	0 to 200 kPa	1 Hz	2 kPa	--	2 kPa	Qualified.
PdT-P139-27-3	Intact-loop venturi, Channel C.	0 to 200 kPa	1 Hz	2 kPa	--	2 kPa	Qualified.
PdT-P139-030	Across RV just beyond intact-loop inlet and outlet nozzles.	0 to 350 kPa	1 Hz	3.5 kPa	--	3.5 kPa	Qualified.
PRESSURE ^j							
<u>Broken Loop</u>							
FF-RJ-001	Broken-loop cold leg at DTT flange.	0.1 to 21 MPa ^j	1 Hz	0.12 MPa	0 MPa 10 MPa 20 MPa	0.077 MPa ^k 0.096 MPa 0.14 MPa	Qualified.
FF-RJ-002	Broken-loop hot leg at DTT flange.	0.1 to 21 MPa	1 Hz	0.12 MPa	0 MPa 10 MPa 20 MPa	0.077 MPa 0.096 MPa 0.14 MPa	Qualified.

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty ($\pm$)	After Experiment Initiation		Comments
					Reading	Uncertainty ($\pm$)	
PRESSURE (continued)							
Intact Loop							
PF-PC-S05	Pressure relief line upstream from experiment relief valve.	0 to 17.2 MPa	1 Hz	0.11 MPa	0 MPa 10 MPa 17 MPa	0.077 MPa 0.096 MPa 0.12 MPa	Qualified.
PF-PC-S06	Pressure relief line upstream from experiment relief valve.	0 to 17.2 MPa	1 Hz	0.11 MPa	0 MPa 10 MPa 17 MPa	0.077 MPa 0.096 MPa 0.12 MPa	Qualified.
PF-PC-S07	Pressure relief line downstream from experiment PORV.	0 to 17.2 MPa	1 Hz	0.077 MPa	0 MPa 10 MPa 17 MPa	0.077 MPa 0.096 MPa 0.12 MPa	Qualified.
PF-PC-001	Intact-loop cold leg at DTT flange.	0.1 to 21 MPa	1 Hz	0.12 MPa	0 MPa 10 MPa 20 MPa	0.077 MPa 0.096 MPa 0.14 MPa	Qualified.
PF-PC-002	Intact-loop hot leg at DTT flange.	0.1 to 21 MPa	1 Hz	0.12 MPa	0 MPa 10 MPa 20 MPa	0.077 MPa 0.096 MPa 0.14 MPa	Qualified.
PF-PC-004	Intact-loop pressurizer vapor space.	0.1 to 21 MPa	1 Hz	0.12 MPa	0 MPa 10 MPa 20 MPa	0.077 MPa 0.096 MPa 0.14 MPa	Qualified.
PF-PC-005	Intact-loop reference pressure between SG outlet and PCP inlet.	0 to 17.2 MPa	1 Hz	0.06 MPa	0 MPa 10 MPa 17 MPa	0.043 MPa 0.052 MPa 0.067 MPa	Qualified.
PF-PC-006	Intact-loop reference pressure between SG outlet and PCP inlet.	0 to 17.2 MPa	1 Hz	0.06 MPa	0 MPa 10 MPa 17 MPa	0.043 MPa 0.052 MPa 0.067 MPa	Qualified.
Secondary Coolant System							
FE-SCS-001	SG dome pressure.	0.1 to 7.0 MPa	1 Hz	0.084 MPa	0 MPa 3.5 MPa 7 MPa	0.077 MPa 0.080 MPa 0.087 MPa	Qualified.

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
PRESSURE (continued)							
<u>Blowdown Sup- pression System</u>							
PF-SV-003	BST across from Downcomer 1 (south end), 157.5° from top vertical (CW looking north).	85 to 700 kPa	1 Hz	13 kPa	85 kPa	13.0 kPa	
					200 kPa	13.0 kPa	
					700 kPa	13.4 kPa	
PF-SV-014	BST header above Downcomer 4, 327° from top vertical (CW looking north).	85 to 700 kPa	1 Hz	13 kPa	85 kPa	13.0 kPa	
					200 kPa	13.0 kPa	
					700 kPa	13.4 kPa	
PF-SV-016	BST across from Downcomer 1, 230° from top vertical (CW looking north).	85 to 700 kPa	1 Hz	13 kPa	85 kPa	13.0 kPa	
					200 kPa	13.0 kPa	
					700 kPa	13.4 kPa	
PF-SV-017	BST, 1.38 m north of Downcomer 3 centerline, 0° from top vertical (CW looking north).	85 to 700 kPa	1 Hz	13 kPa	85 kPa	13.0 kPa	
					200 kPa	13.0 kPa	
					700 kPa	13.4 kPa	
PF-SV-018	BST header above Downcomer 1.	85 to 700 kPa	1 Hz	13 kPa	85 kPa	13.0 kPa	
					200 kPa	13.0 kPa	
					700 kPa	13.4 kPa	
PF-SV-044	BST bottom under Downcomer 3.	85 to 700 kPa	1 Hz	13 kPa	85 kPa	13.0 kPa	
					200 kPa	13.0 kPa	
					700 kPa	13.4 kPa	
PF-SV-055	BST top, 0.15 m north of Downcomer 4 centerline.	85 to 700 kPa	1 Hz	13 kPa	85 kPa	13.0 kPa	
					200 kPa	13.0 kPa	
					700 kPa	13.4 kPa	
PF-SV-060	BST top above Down- comer 1.	85 to 700 kPa	1 Hz	13 kPa	85 kPa	13.0 kPa	
					200 kPa	13.0 kPa	
					700 kPa	13.4 kPa	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
PRESSURE (continued)							
Reactor Vessel							
PE-1ST-001A	Downcomer Stalk 1, 0.62 m above RV bottom, high range.	0.1 to 21 MPa	1 Hz	0.12 MPa	0 MPa 10 MPa 20 MPa	0.077 MPa 0.096 MPa 0.14 MPa	Qualified.
PF-1ST-003A	Downcomer Stalk 1, 5.32 m above RV bottom, high range.	0.1 to 21 MPa	1 Hz	0.12 MPa	0 MPa 10 MPa 20 MPa	0.077 MPa 0.096 MPa 0.14 MPa	Qualified.
PE-1UP-001A	Above Fuel Assembly 1 upper end box.	0.1 to 21 MPa	1 Hz	0.12 MPa	0 MPa 10 MPa 20 MPa	0.077 MPa 0.096 MPa 0.14 MPa	Qualified.
PF-1UP-001A1	Above Fuel Assembly 1 upper end box.	0.1 to 21 MPa	1 Hz	0.12 MPa	0 MPa 10 MPa 20 MPa	0.077 MPa 0.096 MPa 0.14 MPa	Qualified.
PF-5C09-P	Plenum of fuel rod at Row C, Column 9 of Fuel Assembly 5.	0.8 to 17.2 MPa	1 Hz	--	0 MPa 10 MPa 17 MPa	0.21 MPa 0.24 MPa 0.27 MPa	Failed.
PF-5F09-P	Plenum of fuel rod at Row F, Column 9 of Fuel Assembly 5.	0.8 to 17.2 MPa	1 Hz	--	0 MPa 10 MPa 17 MPa	0.21 MPa 0.24 MPa 0.27 MPa	
PF-5G04-P	Plenum of fuel rod at Row G, Column 4 of Fuel Assembly 5.	0.8 to 17.2 MPa	1 Hz	--	0 MPa 10 MPa 17 MPa	0.21 MPa 0.24 MPa 0.27 MPa	
PF-5H02-P	Plenum of fuel rod at Row H, Column 2 of Fuel Assembly 5.	0.8 to 17.2 MPa	1 Hz	--	0 MPa 10 MPa 17 MPa	0.21 MPa 0.24 MPa 0.27 MPa	
PF-5I04-P	Plenum of fuel rod at Row I, Column 4 of Fuel Assembly 5.	0.8 to 17.2 MPa	1 Hz	--	0 MPa 10 MPa 17 MPa	0.21 MPa 0.24 MPa 0.27 MPa	
PF-5I14-P	Plenum of fuel rod at Row I, Column 14 of Fuel Assembly 5.	0.8 to 17.2 MPa	1 Hz	--	0 MPa 10 MPa 17 MPa	0.21 MPa 0.24 MPa 0.27 MPa	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
<u>PRESSURE</u> (continued)							
<u>Reactor Vessel</u> (continued)							
PF-5J09-P	Plenum of fuel rod at Row J, Column 9 of Fuel Assembly 5.	0.8 to 17.2 MPa	1 Hz	--	0 MPa 10 MPa 17 MPa	0.21 MPa 0.24 MPa 0.27 MPa	Failed.
PF-5L07-P	Plenum of fuel rod at Row L, Column 7 of Fuel Assembly 5.	0.8 to 17.2 MPa	1 Hz	--	0 MPa 10 MPa 17 MPa	0.21 MPa 0.24 MPa 0.27 MPa	
PF-5L09-P	Plenum of fuel rod at Row L, Column 9 of Fuel Assembly 5.	0.8 to 17.2 MPa	1 Hz	--	0 MPa 10 MPa 17 MPa	0.21 MPa 0.24 MPa 0.27 MPa	
PF-5M09-P	Plenum of fuel rod at Row M, Column 9 of Fuel Assembly 5.	0.8 to 17.2 MPa	1 Hz	--	0 MPa 10 MPa 17 MPa	0.21 MPa 0.24 MPa 0.27 MPa	
<u>Secondary Coolant System</u>							
PT-P004-010A	In 10-in. line from SG.	0.1 to 8.3 MPa	1 Hz	0.08 MPa	--	0.08 MPa	Qualified.
PT-P004-022	Condensate receiver upstream from inlet to air-cooled condenser header.	0.1 to 2.8 MPa	1 Hz	0.03 MPa	--	0.03 MPa	Qualified, after experiment initiation.
PT-P004-034	Downstream from main feedwater pump.	0.1 to 10.3 MPa	100 Hz	0.10 MPa	--	0.10 MPa	Qualified.
PT-P004-085	Upstream from inlet to air-cooled condenser header.	0.1 to 2.8 MPa	1 Hz	0.03 MPa	--	0.03 MPa	
<u>Emergency Core Cooling System</u>							
PT-P120-029	Accumulator B.	0.1 to 7.0 MPa	1 Hz	0.05 MPa	--	0.05 MPa	
PT-P120-043	Accumulator A.	0.1 to 7.0 MPa	1 Hz	0.05 MPa	--	0.05 MPa	
PT-P120-061	ECC injection.	0.1 to 21 MPa	1 Hz	0.15 MPa	--	0.15 MPa	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
PRESSURE (continued)							
<u>Emergency Core Cooling System (continued)</u>							
PT-P120-074	LP1B Pump B discharge.	0.1 to 7.0 MPa	1 Hz	0.05 MPa	--	0.05 MPa	
PT-P120-083	LP1S Pump A discharge.	0.1 to 7.0 MPa	1 Hz	0.05 MPa	--	0.05 MPa	
<u>Blowdown Sup- pression Tank</u>							
PT-P138-055	BST top, 1.22 m north of Downcomer 1.	80 to 700 kPa	1 Hz	5.0 kPa	--	5.0 kPa	
PT-P138-056	BST top, 1.24 m north of Downcomer 2.	80 to 700 kPa	1 Hz	5.0 kPa	--	5.0 kPa	
PT-P138-057	BST vapor space, Channel C.	80 to 700 kPa	1 Hz	5.0 kPa	--	5.0 kPa	
<u>Intact Loop</u>							
PT-P139-002	Intact-loop hot leg at venturi on bottom.	0.1 to 21 MPa	1 Hz	0.15 MPa	--	0.15 MPa	Qualified.
PT-P139-003	Intact-loop hot leg at venturi on left side when looking toward SG.	0.1 to 21 MPa	1 Hz	0.15 MPa	--	0.15 MPa	Qualified.
PT-P139-004	Intact-loop hot leg at venturi on right side when looking toward SG.	0.1 to 21 MPa	1 Hz	0.15 MPa	--	0.15 MPa	Qualified.
PT-P139-05-1	Pressurizer, 1.88 m above bottom (vapor space).	0.1 to 17.2 MPa	1 Hz	0.12 MPa	--	0.12 MPa	Qualified.
REACTIVITY							
<u>Reactor Vessel</u>							
RE-TRM-86-5	Transient reactivity meter in shield tank.	±0.145 Rho	1 Hz	0.01 Rho	--	0.01 Rho	
RE-TRM-86-6	Transient reactivity meter in shield tank.	±0.145 Rho	1 Hz	0.01 Rho	--	0.01 Rho	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
POWER							
Reactor Vessel							
RE-T-77-1A2	Power range, Channel A level.	0 to 62.5 MW	1 Hz	2.0 MW	--	2.0 MW	Qualified.
RE-T-77-2A2	Power range, Channel B level.	0 to 62.5 MW	1 Hz	2.0 MW	--	2.0 MW	Qualified.
RE-T-77-3A2	Power range, Channel C level.	0 to 62.5 MW	1 Hz	2.0 MW	--	2.0 MW	Qualified.
RE-T-87-4A2	Power range, Channel D level.	0 to 125% power	1 Hz	3% power	--	3% power	Qualified.
PUMP SPEED							
Intact Loop							
RPE-PC-001	PCP-1.	0 to 4500 rpm	1 Hz	10.2 rpm	1000 rpm 2000 rpm 3000 rpm 4000 rpm	8.0 rpm 8.9 rpm 10.1 rpm 11.7 rpm	Qualified.
RPE-PC-002	PCP-2.	0 to 4500 rpm	1 Hz	10.1 rpm	1000 rpm 2000 rpm 3000 rpm 4000 rpm	8.0 rpm 8.9 rpm 10.1 rpm 11.7 rpm	Qualified.
TEMPERATURE							
Reactor Vessel							
TC-5C07-27	Centerline of Fuel Assembly 5, Row C, Column 7 at 0.69 m above bottom of fuel rod.	400 to 2600 K	1 Hz	74.0 K	600 K 1200 K 1800 K 2400 K	13.0 K ¹ 37.5 K 62.5 K 87.0 K	Qualified.
TC-5D06-27	Centerline of Fuel Assembly 5, Row D, Column 6 at 0.69 m above bottom of fuel rod.	400 to 2600 K	1 Hz	78.8 K	600 K 1200 K 1800 K 2400 K	13.0 K 37.5 K 62.5 K 87.0 K	Qualified.
TC-5D07-27	Centerline of Fuel Assembly 5, Row D, Column 7 at 0.69 m above bottom of fuel rod.	400 to 2600 K	1 Hz	75.1 K	600 K 1200 K 1800 K 2400 K	13.0 K 37.5 K 62.5 K 87.0 K	Qualified.

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TC-5D09-27	Centerline of Fuel Assembly 5, Row D, Column 9 at 0.69 m above bottom of fuel rod.	400 to 2600 K	1 Hz	78.0 K	600 K	13.0 K	Qualified.
					1200 K	37.5 K	
					1800 K	62.5 K	
					2400 K	87.0 K	
TC-5D10-27	Centerline of Fuel Assembly 5, Row D, Column 10 at 0.69 m above bottom of fuel rod.	400 to 2600 K	1 Hz	79.4 K	600 K	13.0 K	Qualified.
					1200 K	37.5 K	
					1800 K	62.5 K	
					2400 K	87.0 K	
<u>Broken Loop</u>							
TF-RL-001B	Broken-loop cold leg DTT flange at middle of pipe.	255 to 590 K	1 Hz	4.3 K	400 K	3.8 K	Qualified, no other measurement for direct comparison.
					500 K	4.0 K	
					550 K	4.2 K	
					600 K	4.7 K	
TF-RL-002B	Broken-loop hot leg at middle of DTT flange.	255 to 590 K	1 Hz	4.3 K	400 K	3.8 K	Qualified, no other measurement for direct comparison.
					500 K	4.0 K	
					550 K	4.2 K	
					600 K	4.7 K	
TF-RL-003	Broken loop in reflood assist bypass system, on outside of pipe.	255 to 590 K	1 Hz	4.2 K	400 K	3.8 K	
					500 K	4.0 K	
					550 K	4.2 K	
					600 K	4.7 K	
<u>Intact Loop</u>							
TF-PC-S03	Pressure relief line upstream from experiment relief valve.	255 to 980 K	1 Hz	3.3 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-PC-S04	Pressure relief line upstream from experiment relief valve.	255 to 980 K	1 Hz	3.3 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-PC-S05	Pressure relief line downstream from experiment relief valve.	255 to 980 K	1 Hz	3.3 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Intact Loop</u> (continued)							
TF-PC-S06	Pressure relief line downstream from experiment relief valve.	255 to 980 K	1 Hz	3.3 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-PC-001A	Intact-loop cold leg DTT horizontal flange on west side of pipe.	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-PC-001B	Intact-loop cold leg DTT horizontal flange at center of pipe.	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-PC-001C	Intact-loop cold leg DTT horizontal flange on east side of pipe.	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-PC-002A	Intact-loop hot leg DTT flange at bottom of pipe.	255 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-PC-002B	Intact-loop hot leg DTT flange at middle of pipe.	255 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-PC-002C	Intact-loop hot leg DTT flange at top of pipe.	255 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-PC-005	Next to bottom of ECC Rake 1.	255 to 590 K	1 Hz	4.3 K	400 K	3.8 K	Qualified.
					500 K	4.0 K	
					550 K	4.2 K	
					600 K	4.7 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
<u>TEMPERATURE</u> (continued)							
<u>Intact Loop</u> (continued)							
TF-PC-006	Next to top of ECC Rake 1.	255 to 590 K	1 Hz	4.3 K	400 K	3.8 K	Qualified.
					500 K	4.0 K	
					550 K	4.2 K	
					600 K	4.7 K	
TE-PC-009	Next to bottom of ECC Rake 2.	255 to 590 K	1 Hz	4.3 K	400 K	3.8 K	Qualified.
					500 K	4.0 K	
					550 K	4.2 K	
					600 K	4.7 K	
TE-PC-010	Next to top of ECC Rake 2.	255 to 590 K	1 Hz	--	400 K	3.8 K	Failed.
					500 K	4.0 K	
					550 K	4.2 K	
					600 K	4.7 K	
TF-PC-011	Top of ECC Rake 2.	255 to 590 K	1 Hz	--	400 K	3.8 K	Failed.
					500 K	4.0 K	
					550 K	4.2 K	
					600 K	4.7 K	
<u>Secondary Coolant System</u>							
TF-P004-054	Condensate receiver.	250 to 500 K	1 Hz	2.5 K	--	2.5 K	Qualified, no other measurement for direct comparison.
<u>Emergency Core Cooling System</u>							
TE-P120-027	Accumulator B.	250 to 370 K	1 Hz	2.5 K	--	2.5 K	
TE-P120-041	Accumulator A.	250 to 370 K	1 Hz	2.5 K	--	2.5 K	
<u>Blowdown Sup- pression Tank Spray System</u>							
TE-P13R-137	Outlet of RST spray system heat exchanger.	250 to 420 K	1 Hz	0.7 K	--	0.7 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Blowdown Sup- pression Tank Spray System (continued)</u>							
TE-P138-141	Spray in 3.79-L/s header.	250 to 420 K	1 Hz	1.3 K	--	1.3 K	
TE-P138-142	Spray pump discharge.	250 to 420 K	1 Hz	1.3 K	--	1.3 K	
TE-P138-143	Spray in 13.88-L/s header.	250 to 420 K	1 Hz	1.3 K	--	1.3 K	
<u>Broken Loop</u>							
TE-P138-170	Hot leg warmup line.	73 to 622 K	1 Hz	2.1 K	--	2.1 K	
TE-P138-171	Cold leg warmup line.	172 to 672 K	1 Hz	0.8 K	--	0.8 K	
<u>Intact Loop</u>							
TE-P139-019	Pressurizer vapor space, 0.86 m above heater rods.	280 to 640 K	1 Hz	3.5 K	--	3.5 K	Qualified.
TE-P139-020	Pressurizer liquid volume, 0.36 m above heater rods.	280 to 640 K	1 Hz	3.5 K	--	3.5 K	Qualified.
TE-P139-20-1	Pressurizer liquid volume.	280 to 640 K	1 Hz	3.5 K	--	3.5 K	Qualified.
TE-P139-28-2	Intact-loop cold leg.	530 to 620 K	1 Hz	--	--	1.6 K	Failed.
TE-P139-029	Intact-loop cold leg.	280 to 620 K	1 Hz	1.6 K	--	1.6 K	Qualified.
TE-P139-32-1	Intact-loop hot leg.	280 to 620 K	1 Hz	1.7 K	--	1.7 K	Qualified.
<u>Primary Com- ponent Cooling System</u>							
TE-P141-094	Downstream from primary component cooling system heat exchanger.	275 to 350 K	1 Hz	0.3 K	--	0.3 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Primary Com- ponent Cooling System (continued)</u>							
TF-P141-095	Upstream from primary component cooling system heat exchanger.	275 to 350 K	1 Hz	0.3 K	--	0.3 K	
<u>Intact Loop</u>							
TF-SG-001	Intact-loop SG inlet plenum.	255 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-SG-001A	Intact-loop SG inlet plenum.	255 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-SG-002	Intact-loop SG outlet plenum.	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-SG-002A	Intact-loop SG outlet plenum.	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
<u>Secondary Coolant System</u>							
TF-SG-003	SG secondary side down- comer, 0.25 m above top of tube sheet.	255 to 590 K	1 Hz	4.1 K	400 K	3.8 K	Qualified.
					500 K	4.0 K	
					550 K	4.2 K	
					600 K	4.7 K	
TF-SG-004	SG secondary side down- comer, 2.12 m above top of tube sheet.	255 to 590 K	1 Hz	--	400 K	3.8 K	Failed.
					500 K	4.0 K	
					550 K	4.2 K	
					600 K	4.7 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Secondary Coolant System (continued)</u>							
TE-SG-005	SG secondary side down- comer, 2.92 m above top of tube sheet.	255 to 590 K	1 Hz	4.1 K	400 K 500 K 550 K 600 K	3.8 K 4.0 K 4.2 K 4.7 K	Qualified.
<u>Blowdown Sup- pression System</u>							
TF-SV-001	BST, 0.3 m north of Downcomer 1, 0.53 m east of tank centerline, 2.72 m from tank bottom.	255 to 480 K	1 Hz	3.0 K	--	3.0 K	Qualified.
TF-SV-002	BST, 0.3 m north of Downcomer 1, 0.53 m east of tank centerline, 2.36 m from tank bottom.	255 to 480 K	1 Hz	3.0 K	--	3.0 K	Qualified.
TF-SV-003	BST, 0.3 m north of Downcomer 1, 0.53 m east of tank centerline, 1.90 m from tank bottom.	255 to 480 K	1 Hz	3.0 K	--	3.0 K	Qualified.
TF-SV-004	BST, 0.3 m north of Downcomer 1, 0.53 m east of tank centerline, 1.45 m from tank bottom.	255 to 480 K	1 Hz	3.0 K	--	3.0 K	Qualified.
TF-SV-006	BST, 0.3 m north of Downcomer 1, 0.53 m east of tank centerline, 0.37 m from tank bottom.	255 to 480 K	1 Hz	3.0 K	--	3.0 K	Qualified.
TF-SV-007	BST, 0.3 m north of Downcomer 3, 0.53 m east of tank centerline, 2.72 m from tank bottom.	255 to 480 K	1 Hz	3.0 K	--	3.0 K	Qualified.
TF-SV-008	BST, 0.3 m north of Downcomer 3, 0.53 m east of tank centerline, 2.36 m from tank bottom.	255 to 480 K	1 Hz	3.0 K	--	3.0 K	Qualified.

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Blowdown Sup- pression System (continued)</u>							
TF-SV-009	BST, 0.3 m north of Downcomer 3, 0.53 m east of tank centerline, 1.90 m from tank bottom.	255 to 480 K	1 Hz	3.0 K	--	3.0 K	Qualified.
TF-SV-010	BST, 0.3 m north of Downcomer 3, 0.53 m east of tank centerline, 1.45 m from tank bottom.	255 to 480 K	1 Hz	3.0 K	--	3.0 K	Qualified.
TF-SV-011	BST, 0.3 m north of Downcomer 3, 0.53 m east of tank centerline, 0.99 m from tank bottom.	255 to 480 K	1 Hz	3.0 K	--	3.0 K	Qualified.
TF-SV-012	BST, 0.3 m north of Downcomer 3, 0.53 m east of tank centerline, 0.37 m from tank bottom.	255 to 480 K	1 Hz	3.0 K	--	3.0 K	Failed.
<u>Reactor Vessel</u>							
TF-1A11-030	Cladding on Fuel Assembly 1, Row A, Column 11, 0.76 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.
TF-1B10-037	Cladding on Fuel Assembly 1, Row B, Column 10, 0.94 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.
TF-1B11-028	Cladding on Fuel Assembly 1, Row B, Column 11, at 0.71 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.
TF-1B11-032	Cladding on Fuel Assembly 1, Row B, Column 11, at 0.81 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TF-1B12-026	Cladding on Fuel Assembly 1, Row B, Column 12, 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-1C11-021	Cladding on Fuel Assembly 1, Row C, Column 11, 0.53 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-1C11-039	Cladding on Fuel Assembly 1, Row C, Column 11, 0.99 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-1F07-015	Cladding on Fuel Assembly 1, Row F, Column 7, 0.38 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-1F07-021	Cladding on Fuel Assembly 1, Row F, Column 7, 0.53 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-1F07-026	Cladding on Fuel Assembly 1, Row F, Column 7, 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-1F07-030	Cladding on Fuel Assembly 1, Row F, Column 7, 0.76 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-11P-001	Fuel Assembly 1 lower end box.	310 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TE-1LP-002	Fuel Assembly 1 lower end box.	310 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-1ST-001	Downcomer Stalk 1, 4.8 m from RV bottom.	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-1ST-002	Downcomer Stalk 1, 4.2 m from RV bottom.	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-1ST-003	Downcomer Stalk 1, 3.59 m from RV bottom.	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-1ST-004	Downcomer Stalk 1, 2.98 m from RV bottom.	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-1ST-005	Downcomer Stalk 1, 2.37 m from RV bottom.	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-1ST-006	Downcomer Stalk 1, 1.76 m from RV bottom.	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-1ST-008	Downcomer Stalk 1, 0.74 m from RV bottom.	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TF-1ST-009	Downcomer Stalk 1, 0.64 m from RV bottom.	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-1ST-010	Downcomer Stalk 1, 0.54 m from RV bottom.	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-1ST-011	Downcomer Stalk 1, 0.44 m from RV bottom.	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-1ST-012	Downcomer Stalk 1, 0.34 m from RV bottom.	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-1ST-013	Downcomer Stalk 1, 0.24 m from RV bottom.	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-1ST-014	Downcomer Stalk 1, 1.17 m from RV bottom (inside of DTT).	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-1ST-015	Downcomer Stalk 1, 1 m from RV bottom (inside of DTT).	255 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-1UP-001	Fuel Assembly 1 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TE-1UP-002	Fuel Assembly 1 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-1UP-004	Fuel Assembly 1 support column above RV nozzle.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-1UP-005	DTT FE-1UP-1 above Fuel Assembly 1.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-1UP-006	Fuel Assembly 1 support column.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-1UP-007	Fuel Assembly 1 support column.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-2E08-011	Cladding on Fuel Assembly 2, Row E, Column 8 at 0.28 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-2E08-030	Cladding on Fuel Assembly 2, Row E, Column 8 at 0.76 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-2E08-045	Cladding on Fuel Assembly 2, Row E, Column 8 at 1.14 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TF-2F07-015	Cladding on Fuel Assembly 2, Row F, Column 7 at 0.38 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-2F07-037	Cladding on Fuel Assembly 2, Row F, Column 7 at 0.94 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-2F08-02R	Cladding on Fuel Assembly 2, Row F, Column 8 at 0.71 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-2F08-032	Cladding on Fuel Assembly 2, Row F, Column 8 at 0.81 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-2F09-026	Cladding on Fuel Assembly 2, Row F, Column 9 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-2F09-041	Cladding on Fuel Assembly 2, Row F, Column 9 at 1.04 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-2G02-030	Cladding on Fuel Assembly 2, Row G, Column 2 at 0.76 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-2G08-021	Cladding on Fuel Assembly 2, Row G, Column 8 at 0.53 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TF-2G08-039	Cladding on Fuel Assembly 2, Row G, Column 8 at 0.99 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-2C14-011	Cladding on Fuel Assembly 2, Row G, Column 14 at 0.28 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-2C14-030	Cladding on Fuel Assembly 2, Row G, Column 14 at 0.76 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.7 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-2C14-045	Cladding on Fuel Assembly 2, Row G, Column 14 at 1.14 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-2H01-037	Cladding on Fuel Assembly 2, Row H, Column 1 at 0.94 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-2H02-028	Cladding on Fuel Assembly 2, Row H, Column 2 at 0.71 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-2H02-032	Cladding on Fuel Assembly 2, Row H, Column 2 at 0.81 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-2H03-026	Cladding on Fuel Assembly 2, Row H, Column 3 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TE-2H08-039	Guide tube for Fuel Assembly 2, Row H, Column 8 at 0.99 m above bottom of guide tube.	420 to 1530 K	1 Hz	5.3 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.
TE-2H13-021	Cladding on Fuel Assembly 2, Row H, Column 13 at 0.53 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.
TE-2H13-049	Cladding on Fuel Assembly 2, Row H, Column 13 at 1.24 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.7 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.
TE-2H14-028	Cladding on Fuel Assembly 2, Row H, Column 14 at 0.71 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.
TE-2H14-032	Cladding on Fuel Assembly 2, Row H, Column 14 at 0.81 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.7 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.
TE-2H15-026	Cladding on Fuel Assembly 2, Row H, Column 15 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.8 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.
TE-2H15-041	Cladding on Fuel Assembly 2, Row H, Column 15 at 1.04 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.
TF-2I02-021	Cladding on Fuel Assembly 2, Row I, Column 2 at 0.53 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.

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TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
Reactor Vessel (continued)							
TE-2102-039	Cladding on Fuel Assembly 2, Row I, Column 2 at 0.99 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.3 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-2114-021	Cladding on Fuel Assembly 2, Row I, Column 14 at 0.53 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-2114-039	Cladding on Fuel Assembly 2, Row I, Column 14 at 0.99 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.7 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-21P-001	Fuel Assembly 2 lower end box.	310 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-21P-002	Fuel Assembly 2 lower end box.	310 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-21P-003	Fuel Assembly 2 lower end box.	310 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-21P-001	Fuel Assembly 2 upper end box.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-21P-002	Fuel Assembly 2 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TF-2UP-003	Fuel Assembly 2 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-2UP-004	Fuel Assembly 2 support column.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-2UP-005	Fuel Assembly 2 support column.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-3A11-030	Cladding on Fuel Assembly 3, Row A, Column 11 at 0.76 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-3B10-037	Cladding on Fuel Assembly 3, Row B, Column 10 at 0.94 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-3B11-028	Cladding on Fuel Assembly 3, Row B, Column 11 at 0.71 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-3B11-032	Cladding on Fuel Assembly 3, Row B, Column 11 at 0.81 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.7 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-3B12-026	Cladding on Fuel Assembly 3, Row B, Column 12 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.7 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TE-3C11-021	Cladding on Fuel Assembly 3, Row C, Column 11 at 0.53 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-3C11-039	Cladding on Fuel Assembly 3, Row C, Column 11 at 0.99 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-3F07-015	Cladding on Fuel Assembly 3, Row F, Column 7 at 0.38 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.3 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-3F07-021	Cladding on Fuel Assembly 3, Row F, Column 7 at 0.53 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-3F07-026	Cladding on Fuel Assembly 3, Row F, Column 7 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-3F07-030	Cladding on Fuel Assembly 3, Row F, Column 7 at 0.76 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-3LP-001	Fuel Assembly 3 lower end box.	310 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-3LP-002	Fuel Assembly 3 lower end box.	310 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TE-3UP-001	Fuel Assembly 3 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-3UP-003	Fuel Assembly 3 support column above RV nozzle.	310 to 980 K	1 Hz	—	400 K	3.3 K	
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-3UP-006	Fuel Assembly 3 support column.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-3UP-008	Liquid level transducer above Fuel Assembly 3.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-3UP-010	Liquid level transducer above Fuel Assembly 3.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-3UP-011	Liquid level transducer above Fuel Assembly 3.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-3UP-012	Liquid level transducer above Fuel Assembly 3.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-3UP-013	Liquid level transducer above Fuel Assembly 3.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TF-3UP-014	Liquid level transducer above Fuel Assembly 3.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-3UP-015	Liquid level transducer above Fuel Assembly 3.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-3UP-016	Liquid level transducer above Fuel Assembly 3.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-4F08-011	Cladding on Fuel Assembly 4, Row E, Column 8 at 0.28 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4F08-030	Cladding on Fuel Assembly 4, Row E, Column 8 at 0.76 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-4F08-045	Cladding on Fuel Assembly 4, Row E, Column 8 at 1.14 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-4F07-015	Cladding on Fuel Assembly 4, Row F, Column 15 at 0.38 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.3 K	150 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-4F07-037	Cladding on Fuel Assembly 4, Row F, Column 7 at 0.94 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
Reactor Vessel (continued)							
TE-4F08-028	Cladding on Fuel Assembly 4, Row F, Column 8 at 0.71 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4F08-032	Cladding on Fuel Assembly 4, Row F, Column 8 at 0.81 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4F09-026	Cladding on Fuel Assembly 4, Row F, Column 9 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4F09-041	Cladding on Fuel Assembly 4, Row F, Column 9 at 1.06 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4G02-030	Cladding on Fuel Assembly 4, Row G, Column 2 at 0.76 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4G08-021	Cladding on Fuel Assembly 4, Row G, Column 8 at 0.53 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4G08-039	Cladding on Fuel Assembly 4, Row G, Column 8 at 0.99 m above bottom of fuel rod.	420 to 1530 K	1 Hz	--	450 K	4.0 K	Failed.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4G14-011	Cladding on Fuel Assembly 4, Row G, Column 14 at 0.28 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TE-4G14-030	Cladding on Fuel Assembly 4, Row G, Column 14 at 0.76 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.7 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4G14-045	Cladding on Fuel Assembly 4, Row G, Column 14 at 1.14 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.7 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4H01-037	Cladding on Fuel Assembly 4, Row H, Column 1 at 0.94 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4H02-028	Cladding on Fuel Assembly 4, Row H, Column 2 at 0.71 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4H02-032	Cladding on Fuel Assembly 4, Row H, Column 2 at 0.81 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4H03-026	Cladding on Fuel Assembly 4, Row H, Column 3 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4H13-015	Cladding on Fuel Assembly 4, Row H, Column 13 at 0.38 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4H13-037	Cladding on Fuel Assembly 4, Row H, Column 13 at 0.94 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.7 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TE-4H14-028	Cladding on Fuel Assembly 4, Row H, Column 14 at 0.71 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.7 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4H14-032	Cladding on Fuel Assembly 4, Row H, Column 14 at 0.81 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.7 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4H15-026	Cladding on Fuel Assembly 4, Row H, Column 15 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.9 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4H15-041	Cladding on Fuel Assembly 4, Row H, Column 15 at 1.04 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.7 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-4I02-021	Cladding on Fuel Assembly 4, Row I, Column 2 at 0.53 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.3 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-4I02-039	Cladding on Fuel Assembly 4, Row I, Column 2 at 0.99 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4I14-021	Cladding on Fuel Assembly 4, Row I, Column 14 at 0.53 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-4I14-039	Cladding on Fuel Assembly 4, Row I, Column 14 at 0.99 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.8 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TF-4LP-001	Fuel Assembly 4 lower end box.	310 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-4LP-002	Fuel Assembly 4 lower end box.	310 to 980 K	1 Hz	4.0 K	400 K	3.3 K	
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-4LP-003	Fuel Assembly 4 lower end box.	310 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-4UP-001	Fuel Assembly 4 upper end box.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-4UP-002	Fuel Assembly 4 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-4UP-003	Fuel Assembly 4 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-4UP-004	Fuel Assembly 4 support column.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-4UP-005	Fuel Assembly 4 support column.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TE-5C06-024	Guide tube for Fuel Assembly 5, Row C, Column 6 at 0.61 m above bottom of guide tube.	420 to 1530 K	1 Hz	5.2 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5C07-027	Cladding on Fuel Assembly 5, Row C, Column 7 at 0.69 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5C07-031	Cladding on Fuel Assembly 5, Row C, Column 7 at 0.79 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5C07-43.8	Cladding on Fuel Assembly 5, Row C, Column 7 at 1.11 m above bottom of fuel rod.	420 to 1530 K	1 Hz	—	450 K	4.0 K	Failed.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5D06-027	Cladding on Fuel Assembly 5, Row D, Column 6 at 0.69 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.4 K	450 K	5.2 K	Qualified.
					600 K	6.5 K	
					900 K	10.6 K	
					1500 K	19.9 K	
TE-5D06-031	Cladding on Fuel Assembly 5, Row D, Column 6 at 0.79 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.5 K	450 K	5.2 K	Qualified.
					600 K	6.5 K	
					900 K	10.6 K	
					1500 K	19.9 K	
TE-5D6-43.8	Cladding on Fuel Assembly 5, Row D, Column 6 at 1.11 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.5 K	450 K	5.2 K	Qualified.
					600 K	6.5 K	
					900 K	10.6 K	
					1500 K	19.9 K	
TE-5D07-027	Cladding on Fuel Assembly 5, Row D, Column 7 at 0.69 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.7 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TE-5D07-031	Cladding on Fuel Assembly 5, Row D, Column 7 at 0.79 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.5 K	450 K	5.2 K	Qualified.
					600 K	6.5 K	
					900 K	10.6 K	
					1500 K	19.9 K	
TE-5D07-43.8	Cladding on Fuel Assembly 5, Row D, Column 7 at 1.11 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5F03-024	Guide tube for Fuel Assembly 5, Row F, Column 3 at 0.61 m above bottom of guide tube.	420 to 1530 K	1 Hz	5.2 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5F04-015	Cladding on Fuel Assembly 5, Row F, Column 4 at 0.38 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.3 K	450 K	5.2 K	Qualified.
					600 K	6.5 K	
					900 K	10.6 K	
					1500 K	19.9 K	
TE-5F04-026	Cladding on Fuel Assembly 5, Row F, Column 4 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.5 K	450 K	5.2 K	Qualified.
					600 K	6.5 K	
					900 K	10.6 K	
					1500 K	19.9 K	
TE-5F04-032	Cladding on Fuel Assembly 5, Row F, Column 4 at 0.81 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.6 K	450 K	5.2 K	Qualified.
					600 K	6.5 K	
					900 K	10.6 K	
					1500 K	19.9 K	
TE-5F04-062	Cladding on Fuel Assembly 5, Row F, Column 4 at 1.57 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5F07-026	Cladding on Fuel Assembly 5, Row F, Column 7 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TE-5F08-026	Cladding on Fuel Assembly 5, Row F, Column 8 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5G06-011	Cladding on Fuel Assembly 5, Row G, Column 6 at 0.28 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5G06-030	Cladding on Fuel Assembly 5, Rod G, Column 6 at 0.76 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5G06-045	Cladding on Fuel Assembly 5, Row G, Column 6 at 1.14 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.5 K	450 K	5.2 K	Qualified.
					600 K	6.5 K	
					900 K	10.6 K	
					1500 K	19.9 K	
TE-5G06-062	Cladding on Fuel Assembly 5, Row G, Column 6 at 1.57 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5H05-002	Cladding on Fuel Assembly 5, Row H, Column 5 at 0.05 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.2 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5H05-015	Cladding on Fuel Assembly 5, Row H, Column 5 at 0.38 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.4 K	450 K	5.2 K	Qualified.
					600 K	6.5 K	
					900 K	10.6 K	
					1500 K	19.9 K	
TE-5H05-049	Cladding on Fuel Assembly 5, Row H, Column 5 at 1.24 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.4 K	450 K	5.2 K	Qualified.
					600 K	6.5 K	
					900 K	10.6 K	
					1500 K	19.9 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TF-SH06-024	Cladding on Fuel Assembly 5, Row H, Column 6 at 0.61 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-SH06-028	Cladding on Fuel Assembly 5, Row H, Column 6 at 0.71 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-SH06-032	Cladding on Fuel Assembly 5, Row H, Column 6 at 0.81 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-SH06-037	Cladding on Fuel Assembly 5, Row H, Column 6 at 0.94 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-SH07-008	Cladding on Fuel Assembly 5, Row H, Column 7 at 0.20 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.3 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-SH07-026	Cladding on Fuel Assembly 5, Row H, Column 7 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-SH07-041	Cladding on Fuel Assembly 5, Row H, Column 7 at 1.04 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-SH07-058	Cladding on Fuel Assembly 5, Row H, Column 7 at 1.47 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TE-5104-027	Cladding on Fuel Assembly 5, Row I, Column 4 at 0.69 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.4 K	450 K	5.2 K	Qualified.
					600 K	6.5 K	
					900 K	10.6 K	
					1500 K	19.9 K	
TE-5104-43.8	Cladding on Fuel Assembly 5, Row I, Column 4 at 1.11 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.5 K	450 K	5.2 K	Qualified.
					600 K	6.5 K	
					900 K	10.6 K	
					1500 K	19.9 K	
TE-5106-005	Cladding on Fuel Assembly 5, Row I, Column 6, at 0.13 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.3 K	450 K	5.2 K	Qualified.
					600 K	6.5 K	
					900 K	10.6 K	
					1500 K	19.9 K	
TE-5106-021	Cladding on Fuel Assembly 5, Row I, Column 6, at 0.53 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.4 K	450 K	5.2 K	Qualified.
					600 K	6.5 K	
					900 K	10.6 K	
					1500 K	19.9 K	
TE-5106-039	Cladding on Fuel Assembly 5, Row I, Column 6 at 0.99 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5106-054	Cladding on Fuel Assembly 5, Row I, Column 6 at 1.37 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5J03-024	Guide tube for Fuel Assembly 5, Row J, Column 3 at 0.61 m above bottom of guide tube.	420 to 1530 K	1 Hz	5.2 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5J04-005	Cladding on Fuel Assembly 5, Row J, Column 4 at 0.13 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.2 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TE-SJ04-021	Cladding on Fuel Assembly 5, Row J, Column 4 at 0.53 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-SJ04-039	Cladding on Fuel Assembly 5, Row J, Column 4 at 0.99 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-SJ04-054	Cladding on Fuel Assembly 5, Row J, Column 4 at 1.37 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-SJ08-026	Cladding on Fuel Assembly 5, Row J, Column 8 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5LP-001	Fuel Assembly 5 lower end box.	310 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-5LP-002	Fuel Assembly 5 lower end box.	310 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-5LP-003	Fuel Assembly 5 lower end box.	310 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-5LP-004	Fuel Assembly 5 lower end box.	310 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TE-5L06-026	Cladding on Fuel Assembly 5, Row L, Column 6 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.4 K	450 K	5.2 K	Qualified.
					600 K	6.5 K	
					900 K	10.6 K	
					1500 K	19.9 K	
TE-5L07-027	Cladding on Fuel Assembly 5, Row L, Column 7 at 0.69 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5L07-43.8	Cladding on Fuel Assembly 5, Row L, Column 7 at 1.11 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5L08-011	Guide tube for Fuel Assembly 5, Row L, Column 8 at 0.28 m above bottom of guide tube.	420 to 1530 K	1 Hz	5.2 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5L08-024	Guide tube for Fuel Assembly 5, Row L, Column 8 at 0.61 m above bottom of guide tube.	420 to 1530 K	1 Hz	5.2 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5L08-039	Guide tube for Fuel Assembly 5, Row L, Column 8 at 0.99 m above bottom of guide tube.	420 to 1530 K	1 Hz	5.3 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5L08-045	Guide tube for Fuel Assembly 5, Row L, Column 8 at 1.14 m above bottom of guide tube.	420 to 1530 K	1 Hz	5.3 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5M06-024	Guide tube for Fuel Assembly 5, Row M, Column 6 at 0.61 m above bottom of guide tube.	420 to 1530 K	1 Hz	5.3 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.7 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TE-5M07-015	Cladding on Fuel Assembly 5, Row L, Column 7 at 0.38 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5M07-026	Cladding on Fuel Assembly 5, Row L, Column 7 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5M07-032	Cladding on Fuel Assembly 5, Row L, Column 7 at 0.81 m above bottom of fuel rod.	420 to 1530 K	1 Hz	6.5 K	450 K	5.2 K	Qualified.
					600 K	6.5 K	
					900 K	10.6 K	
					1500 K	19.9 K	
TE-5M07-062	Cladding on Fuel Assembly 5, Row L, Column 7 at 1.57 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-5UP-003	Fuel Assembly 5 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-5UP-004	Fuel Assembly 5 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-5UP-009	Fuel Assembly 5 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-5UP-010	Fuel Assembly 5 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
Reactor Vessel (continued)							
TE-SUP-011	Fuel Assembly 5 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-SUP-012	Fuel Assembly 5 upper end box.	310 to 980 K	1 Hz	--	400 K	3.3 K	
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-SUP-013	Fuel Assembly 5 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-SUP-014	Fuel Assembly 5 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-SUP-015	Fuel Assembly 5 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-SUP-016	Fuel Assembly 5 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-SUP-017	Fuel Assembly 5 upper end box.	310 to 980 K	1 Hz	--	400 K	3.3 K	
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TE-SUP-018	Fuel Assembly 5 upper end box.	310 to 980 K	1 Hz	--	400 K	3.3 K	
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TF-SUP-019	Fuel Assembly 5 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-SUP-020	Fuel Assembly 5 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-6E08-011	Cladding on Fuel Assembly 6, Row E, Column 8 at 0.28 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-6E08-030	Cladding on Fuel Assembly 6, Row E, Column 8 at 0.76 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-6E08-045	Cladding on Fuel Assembly 6, Row E, Column 8 at 1.14 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-6F07-015	Cladding on Fuel Assembly 6, Row F, Column 7 at 0.38 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-6F07-037	Cladding on Fuel Assembly 6, Row F, Column 7 at 0.94 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-6F08-028	Cladding on Fuel Assembly 6, Row F, Column 8 at 0.71 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.7 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TF-6F08-032	Cladding on Fuel Assembly 6, Row F, Column 8 at 0.81 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-6F09-026	Cladding on Fuel Assembly 6, Row F, Column 9 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-6F09-041	Cladding on Fuel Assembly 6, Row F, Column 9 at 1.06 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-6C02-030	Cladding on Fuel Assembly 6, Row G, Column 2 at 0.76 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-6C08-021	Cladding on Fuel Assembly 6, Row G, Column 8 at 0.53 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-6C08-039	Cladding on Fuel Assembly 6, Row G, Column 8 at 0.99 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-6C14-011	Cladding on Fuel Assembly 6, Row G, Column 14 at 0.28 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-6C14-030	Cladding on Fuel Assembly 6, Row G, Column 14 at 0.76 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.8 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TE-6G14-045	Cladding on Fuel Assembly 6, Row G, Column 14 at 1.14 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.7 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-6H01-037	Cladding on Fuel Assembly 6, Row H, Column 1 at 0.94 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.3 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-6H02-028	Cladding on Fuel Assembly 6, Row H, Column 2 at 0.71 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-6H02-032	Cladding on Fuel Assembly 6, Row H, Column 2 at 0.81 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-6H03-026	Cladding on Fuel Assembly 6, Row H, Column 3 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-6H13-015	Cladding on Fuel Assembly 6, Row H, Column 13 at 0.38 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-6H13-037	Cladding on Fuel Assembly 6, Row H, Column 13 at 0.94 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TE-6H14-028	Cladding on Fuel Assembly 6, Row H, Column 14 at 0.71 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TE-6H14-032	Cladding on Fuel Assembly 6, Row H, Column 14 at 0.81 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.7 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.
TE-6H15-026	Cladding on Fuel Assembly 6, Row H, Column 15 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.8 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.
TE-6H15-041	Cladding on Fuel Assembly 6, Row H, Column 15 at 1.04 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.7 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.
TE-6I02-021	Cladding on Fuel Assembly 6, Row I, Column 2 at 0.53 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.3 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.
TE-6I02-039	Cladding on Fuel Assembly 6, Row I, Column 2 at 0.99 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.4 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.
TE-6I14-021	Cladding on Fuel Assembly 6, Row I, Column 14 at 0.53 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.6 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.
TE-6I14-039	Cladding on Fuel Assembly 6, Row I, Column 14 at 0.99 m above bottom of fuel rod.	420 to 1530 K	1 Hz	5.7 K	450 K 600 K 900 K 1500 K	4.0 K 5.6 K 10.0 K 19.4 K	Qualified.

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TF-6LP-001	Fuel Assembly 6 lower end box.	310 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-6LP-002	Fuel Assembly 6 lower end box.	310 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-6LP-003	Fuel Assembly 6 lower end box.	310 to 980 K	1 Hz	4.0 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-6UP-001	Fuel Assembly 6 upper end box.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-6UP-002	Fuel Assembly 6 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-6UP-003	Fuel Assembly 6 upper end box.	310 to 980 K	1 Hz	4.2 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-6UP-004	Fuel Assembly 6 support column.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	
TF-6UP-005	Fuel Assembly 6 support column.	310 to 980 K	1 Hz	4.1 K	400 K	3.3 K	Qualified.
					500 K	3.6 K	
					600 K	4.3 K	
					1000 K	6.8 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TF-5F08-26	Pellet surface at Fuel Assembly 5, Row F, Column at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	18.8 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-5F12-26	Pellet surface at Fuel Assembly 5, Row F, Column 12 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	17.8 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-5H10-26	Pellet surface at Fuel Assembly 5, Row H, Column 10 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	19.9 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-5I10-26	Pellet surface at Fuel Assembly 5, Row I, Column 10 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	18.0 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-5J08-26	Pellet surface at Fuel Assembly 5, Row J, Column 10 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	19.0 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TF-5J12-26	Pellet surface at Fuel Assembly 5, Row J, Column 12 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	--	450 K	4.0 K	Failed.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TM-5F07-26	Embedded in cladding of Fuel Assembly 5, Row F, Column 7 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	--	450 K	4.0 K	Failed.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TM-5G10-26	Embedded in cladding of Fuel Assembly 5, Row G, Column 10 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	--	450 K	4.0 K	Failed.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TM-5H13-26	Embedded in cladding of Fuel Assembly 5, Row H, Column 13 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	--	450 K	4.0 K	Failed.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TM-5I06-26	Embedded in cladding of Fuel Assembly 5, Row L, Column 6 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	--	450 K	4.0 K	Failed.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TM-5I10-26	Embedded in cladding of Fuel Assembly 5, Row L, Column 10 at 0.66 m above bottom of fuel rod.	420 to 1530 K	1 Hz	--	450 K	4.0 K	Failed.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TP-5C09	Plenum of fuel rod at Row C, Column 9 of Fuel Assembly 5.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TP-5F09	Plenum of fuel rod at Row F, Column 9 of Fuel Assembly 5.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TP-5H02	Plenum of fuel rod at Row H, Column 2 of Fuel Assembly 5.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TP-5I04	Plenum of fuel rod at Row I, Column 4 of Fuel Assembly 5.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Reactor Vessel</u> (continued)							
TP-5114	Plenum of fuel rod at Row I, Column 14 of Fuel Assembly 5.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TP-5109	Plenum of fuel rod at Row J, Column 9 of Fuel Assembly 5.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TP-5107	Plenum of fuel rod at Row L, Column 7 of Fuel Assembly 5.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TP-5109	Plenum of fuel rod at Row L, Column 9 of Fuel Assembly 5.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
TP-5M09	Plenum of fuel rod at Row M, Column 9 of Fuel Assembly 5.	420 to 1530 K	1 Hz	5.5 K	450 K	4.0 K	Qualified.
					600 K	5.6 K	
					900 K	10.0 K	
					1500 K	19.4 K	
<u>Secondary Coolant System</u>							
TT-P004-004	Secondary coolant system feedwater.	370 to 505 K	1 Hz	1.2 K	--	1.2 K	Qualified, no other measurement for direct comparison.
<u>Emergency Core Cooling System</u>							
TT-P120-062	Cold leg injection in 4-in. line upstream from cold leg injection point.	280 to 620 K	1 Hz	1.6 K	--	1.6 K	

TABLE B-2. (continued)

Variable, System, and Detector	Location	Measurement Range	Recording Frequency ^a	Initial Condition Uncertainty (±)	After Experiment Initiation		Comments
					Reading	Uncertainty (±)	
TEMPERATURE (continued)							
<u>Intact loop</u>							
TT-P139-032	Intact loop hot leg primary coolant, Channel A.	535 to 620 K	1 Hz	1.7 K	--	1.7 K	Qualified.
TT-P139-033	Intact loop hot leg primary coolant, Channel B.	535 to 620 K	1 Hz	1.7 K	--	1.7 K	Qualified.
TT-P139-034	Intact loop hot leg primary coolant, Channel C.	535 to 620 K	1 Hz	1.7 K	--	1.7 K	Qualified.

- a. Recording frequency is the measurement channel bandwidth at the 33-dB level.
- b. Reference B-4.
- c. Reference B-5.
- d. Reference B-6.
- e. Reference B-7.
- f. The steam generator liquid level is defined as 0 at 2.95 m above the top of the tube sheet.
- g. Reference B-8.
- h. Reference B-9.
- i. Reference B-10.
- j. Pressure measurements are presented as absolute values.
- k. Reference B-11.
- l. Reference B-12.

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APPENDIX C
PREEXPERIMENT PROCEDURES AND
DATA CONSISTENCY CHECKS

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PREEXPERIMENT PROCEDURES AND DATA CONSISTENCY CHECKS

In preparation for Experiment L9-3, the primary coolant system (PCS) was filled and vented, and the specified system water chemistry was established. Prior to the primary system heatup, several tests were performed on the Loss-of-Fluid Test (LOFT) system. These tests included plant requalification tests, pump coastdown runs, experiment control system checks, and operational verification of newly installed instrumentation. Selected system process instruments were calibrated and an electrical calibration was performed on the data acquisition and visual display system (DAVDS).^{C-1}

The PCS pressure was hydrostatically increased to 1.46, 3.53, 6.98, 10.43, 13.87, and 15.60 MPa at cold plant temperature and zero flow conditions. The DAVDS recorded 20 s of data at each pressure plateau in both the increasing and decreasing directions to determine the degree of sensitivity of the pressure sensing instruments. The system was concurrently inspected for leakage at the various test pressures. The pumps were operated at 15, 20, 30, 40, 50, and 60 Hz with 20 s of data taken at each frequency. During heatup of the plant, the appropriate initial conditions were established for the blowdown suppression tank (BST), accumulator, and borated water storage tank (BWST).

The plant was stabilized at 422, 489, and 555 K during heatup. At each of these temperatures, 20 s of data were recorded for calibration checks and to determine the degree of instrument temperature sensitivity. In addition, the pumps were operated at 20 Hz with 20 s of data taken. At the 555-K stabilization point, the pumps were stopped and 20 s of data were recorded during pump coastdown and zero flow conditions. With the pumps off at the 555-K stabilization point, 20 s of data were taken. Before the reactor was brought critical, the DAVDS was calibrated and the boron concentration in the accumulators, BST, and BWST was verified.

The following discussion describes several techniques used to perform consistency checks on

the data presented in this report. The purpose of these checks is to establish data integrity and to evaluate the performance of a given transducer.

1. Checks of Preexperiment Data

Prior to the experiment, static pressure, steady state flow, zero flow, pump coastdown, isothermal, and high-pressure injection system (HPIS) flow tests were conducted on the LOFT system at various temperatures, pressures, and flow rates. Using the data from these tests, the following checks were performed.

1.1 Absolute Pressure Data. During the approach to initial conditions, a static pressure test was performed at cold plant temperature. After this test, the absolute pressure measurements were compared with two reference pressures (PE-PC-005 and -006). The pressure tests were used to evaluate the slope coefficient of the calibration equations and to evaluate the pressure sensitivity of the transducers.

Prior to the experiment, the BST was vented to the atmosphere and the BST pressure readings were checked against atmospheric pressure.

The steam generator pressures were compared to each other and checked against the temperature in the steam generator by comparing the pressure obtained from the steam tables, using the steam generator temperature, with the pressure transducer readings.

When the accumulator was pressurized, both accumulator pressure transducer readings were checked by comparing one with the other.

1.2 Flow Data. Measurements of fluid flow included pump speed, differential pressure, venturi, turbines and drag discs. The measurements were analyzed primarily to check the zero offset. Turbine and drag disc measurements were also analyzed to check slope coefficient (gain) changes.

1.2.1 Pump Speed Data—The reference measurement for all intact loop flow measurements was primary coolant pump speed, because it is the most accurate and stable of the flow measurements. The pump speed measurement was adjusted using a square wave generator to calibrate the digital-to-analog conversion.

During heatup the zero reading was checked at every zero flow point, and during flow tests the pump speed was checked against pump frequency. Pump speed measurements were checked for consistency by comparison with pump speed as calculated from the primary system motor generator frequencies. This check was valid prior to and during the experiment until the primary system motor generator field breakers were opened. Prior to the experiment, the pump speed was further checked by reviewing the agreement with previous LOFT experiments. Pump operating voltages and currents were evaluated prior to the experiment by calculating the pump electrical horsepower input and the combined pump efficiency. These calculated efficiencies were then compared with previously recorded efficiencies determined during pump requalification tests.

1.2.2 Differential Pressure Data—Zero offsets were determined from flow data, static pressure tests, and temperature sensitivity data derived during the heatup. Steady-state flow conditions for the PCS were then established, and selected PCS pressure drops were compared with predicted values. At various flow conditions, intact-loop flow resistance coefficients were calculated and verified to remain essentially constant and to agree with previously tabulated data. Further consistency checks were performed on the intact loop differential pressure measurements by plotting the square root of the differential pressure against pump speed using data from the pump frequency tests. The results of the curve fits performed on those plots were then used to confirm zero offsets. Both prior to and during the experiment, differential pressure measurements were compared with the differential pressure computed by subtracting appropriate absolute pressure measurements. Pressure closure was calculated for the PCS intact loop.

1.2.3 Venturi Data—Consistency checks were performed by comparing the venturi mass flow rates with each other and venturi mass flow rates from previous LOFT experiments (with the same loop

resistance). A comparison of the venturi with the pump speed consisted of performing a least squares fit of the venturi data versus the pump data (derived from the pump speed frequency test). The results were used to correct any zero offset in the venturi. The corrected venturi data were then used to calculate the average fluid velocity and momentum flux of the intact loop. The computed velocity was compared to the differential pressure measured across the pumps, the steam generator, and the reactor vessel.

In addition, the computed fluid velocity and the momentum flux were compared to the output of the turbines and drag discs in the reactor vessel.

1.2.4 Drag-Disc Turbine Transducer (DTT) Data—Reactor vessel and piping drag disc measurements were compared with values calculated from venturi mass flow, assuming the full flow area. Slope coefficients were calculated, and the effect of temperature on the calibration coefficients was determined.

After the slope coefficients had been verified, the data for a given transducer were plotted against pump speed and a least squares fit performed. The zero offset from this curve fit was used to modify the zero offset of the transducers.

As an independent check, the turbine flowmeter and drag disc data were used to calculate fluid density. These values were then compared to the known single-phase density prior to the experiment. This analysis was performed on all the turbine flowmeter and drag disc measurements with the exception of those that failed.

HPIS flow through the pressure relief line was used to verify the slope coefficients for the break line DTT. The calculated mass flow from the DTT was compared with the mass flow rate from the HPIS flow venturi and the mass flow rate into the BST.

1.3 Gamma Densitometer Data. To evaluate the PCS average fluid densities, calculations were performed using the gamma densitometers. The densitometers were checked for normal operation by recording and examining data tapes approximately one day before the experiment and by observing spectra, count rate data, and live-time data on the densitometer system display console during and immediately before the experiment.

1.4 Level Measurement Data. Four system level measurements were evaluated: (a) BST liquid-level, (b) pressurizer coolant level, (c) reactor vessel coolant level, and (d) steam generator secondary side liquid level. Blowdown suppression tank liquid-level measurements were qualified by comparing the four available measurements. In addition, a sightglass measurement was made prior to the experiment. Similarly, pressurizer liquid level was reviewed by redundant level measurements. The reactor vessel liquid level probes were verified by performing preexperiment conductivity calibrations with the vessel full, under cold and hot plant conditions.

1.5 Thermocouple Data. Temperature measurements were analyzed by comparing them with other temperature data obtained during the isothermal tests. Resistance temperature measurements were used for reference, where they existed. If saturation conditions existed, the temperature was compared with the temperature from the steam tables using pressure measurements as the reference. Temperature measurements outside the primary coolant were compared with any known temperature in the same area.

2. Checks During and After the Experiment

The purpose of these checks was to further establish the data integrity. For each type of measurement, comparable data channels were evaluated and the determination of data consistency was identified. The following is a brief summary of those checks.

2.1 Absolute Pressure Data. During the experiment, the saturated steam temperature was determined from the saturated steam table using pressure transducer data. The computed temperature was compared with the temperature measured by the thermocouple. However, this was valid only during saturation. When complete voiding occurred, the measured temperature increased above the corresponding saturation temperature because of conduction and radiant heating of the detector element by the surrounding warmer environment (pipe walls, etc.).

2.2 Flow Data. Immediately prior to the experiment, flow data were again compared for consistency. In addition, experiment data were

compared with previous similar experiments. A summary of the consistency checks for the pump and flow transducer measurements follows.

2.2.1 Differential Pressure Data—Immediately prior to the experiment, when steady-state operating conditions had been established, the differential pressure measurements around the intact loop were summed and compared with the differential pressure across the primary coolant pumps.

2.2.2 Venturi Data—The initial conditions data from the venturi were checked for data consistency by comparing them with preexperiment flow test data. The flow venturi was used only for steady-state initial conditions information.

2.2.3 Drag-Disc Turbine Transducer (DTT) Data—Initial conditions data were checked by calculating momentum flux from the venturi mass flow rate and from the known density for those DTTs that were not overranged. These values were then compared with the measured values from the DTT.

Experiment data were checked by comparing data from previous experiments. An additional check was made by comparing the basic shape of the velocity or momentum flux curves with a differential pressure close to the DTT.

2.3 Gamma Densitometer Data. Checks of the calibration constants were obtained from the all-liquid readings a few seconds prior to the experiment.

2.4 Liquid Level Data. The BST liquid level was evaluated by comparing four independent level measurements (LT-P138-33, -58, LEPdE-SV-1, and -2). Similarly, the steam generator and pressurizer liquid levels were reviewed by redundant level measurements. The reactor vessel liquid level measurements were examined to verify that no voiding had occurred in the reactor vessel.

2.5 Temperature Data. The temperatures during the experiment were compared with saturation temperatures from the steam tables using pressure data and with previous experimental data. Initial conditions were also checked by comparing all primary coolant thermocouple and resistance thermometer detector measurements. Suppression tank thermocouple measurements were compared in a like manner.

2.6 Additional Postexperiment Procedures and Data Consistency Checks. Following the L9-3 experiment, additional operational verification of selected instrumentation was performed.

The plant temperature was stabilized at 555 and 489 K during cooldown. At each of these temperatures, 20 s of data was recorded for calibration checks and to determine the degree of instrument temperature sensitivity. In addition, the pumps were operated at 0, 15, 20, 30, 40, 50, and 60 Hz in both increasing and decreasing directions with 20 s of data taken at each frequency.

The consistency checks performed on the postexperiment data were the same as those for the preexperiment data described in Section 1 of this appendix.

3. Reference

- C-1. F. S. Miyasaki, *Digital Data Acquisition Program*, ANCR-1250, August 1975.